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ABSTRACT

Developed to help teachers and students deal with some of the current issues in science and technology, this book outlines a system for studying socioscientific problems that can be developed in class and then be applied in a life setting. Issues related to the biological sciences, physical sciences, and science as a social institution are addressed. Each of the topics is approached in a five-step sequence. These include: (1) an introduction (providing a background for the topic); (2) a background reading list (designed to get students started on research); (3) a case study (presenting a real or fictional situation that requires a decision); (4) "buck-stops-here" question (requiring that students make a commitment on the issue addressed in the case study); and (5) additional questions (serving as starting points for further discussion and investigations). A section is included that explains the use of background readings and also identifies major sources of news and comment. (ML)

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science and social issues

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REVISED EDITION

J. Weston Walch, Publisher

David E. Newton

science and social issues

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DEDICATION

For Dan

Who makes it all worthwhile

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Preface to the Second Edition

The original edition of *Science and Social Issues* had been in print only three years when it became obvious that a significant revision of the text was needed. In that short period of time, some major new social and ethical issues began to appear, some older issues seemed somewhat less important, and new data and changing viewpoints altered our outlook on many more familiar issues.

These changes in society, technology, morality, politics, economics, and other aspects of our lives have prompted the revised edition presented here. In preparing this revision, we are struck once more by some important considerations in studying socioscientific issues.

First, we see that what is probably most important in learning about these topics is "mastering" information about the topics themselves. The issues you read and think about today may no longer be of great significance next year or in twenty years. The topics most likely to influence your life in a decade may be unimaginable at this time.

What is important, then, is to be able to develop the skills of research, analysis, and consensus which can be used in understanding *any* socioscientific issue. We suggest that, as you work through case studies in this text, you think not only about the cases themselves, but also about the methods you used in dealing with these problems.

Second, we see how difficult it is for a textbook to provide you with all the information and all the references needed to keep you completely up to date on a topic. We feel somewhat frustrated to realize that by the time this book rolls off the presses, vast amounts of new information will be available on many of the issues we present here. The only solution to this problem we can provide is to encourage you always to look for the most current articles available as you prepare for each of the case studies in this book.

Finally, we have attempted to make the text more current in three ways. First, we have added new data and information which brings the status of existing case studies up to date. Second, relevant new articles have been added to the *Background Reading Lists* wherever possible. And third, you'll find five new topics presented in this edition. These topics cover issues, which, as of mid-1986, are receiving major consideration in the United States and Canada.

Many of the changes in this edition of the text are the result of advice and assistance provided by my students in the College of Professional Studies at the University of San Francisco. I express my most sincere appreciation to them for their help!

David E. Newton
San Francisco
Summer 1986

To the teacher

What are the critical issues facing our nation today? Any list compiled in response to that question would probably include air and water pollution, genetic engineering, behavior modification, abortion, energy resources, health hazards in the environment, questions of land use, and the like. As disparate as these topics appear to be, they share one element in common: All contain an important scientific and/or technological component. In fact, it would probably be not too far amiss to say that most of the crucial questions confronting our society today have come about as the result of advances in science and technology.

Medical research, for example, has brought the American people a level of health care that has seldom been matched in human history. Our understanding of nutrition, public health practices, surgical techniques, organ transplantation, life-prolonging methods, and a host of other medical advances guarantee that many Americans will live a longer, healthier, and safer life.

But the very success of this research has also engendered a whole variety of new social and ethical questions. Under what circumstances should a person be kept alive by artificial means? What new social, psychological, and ethical issues are raised by the prospect of an increasingly larger population of older citizens? What types of medical intervention can and should be made that affect a living being before it is even born? To whom does the responsibility fall for making decisions in cases like these?

The same pattern can be seen over and over again in our society. Scientific or technological "success" presents government, social institutions, and individuals with complex and difficult social, economic, political, ethical, psychological, and religious questions.

How is the educational system to help students in dealing with these questions? Here is a pedagogical question of unusual difficulty. In the first place, most of these issues (if not all) are not single-discipline questions. An understanding of the nuclear power issue, for example, involves information and problem-solving skills from science, economics, sociology, psychology, political science, ethics, and other fields. Whose job is it in the educational system to help students understand this issue? Should the physics instructor accept this responsibility? Or the sociology teacher? Or the social science instructor? Unfortunately, the answer is all too obvious. Since it is, in some sense, *everyone's* responsibility, it turns out to be no one's task. As a result, the issues of nuclear power generation (and similar socioscientific questions) are, most probably, not discussed comprehensively in most schools and colleges today.

A second pedagogical problem is that the issues to which we refer here are not those for which easy answers—or any answers at all—are likely to be found. In an educational system that focuses on giving students the right answers to so many questions, this presents some practical difficulties. We can tell students the "right" answers about atomic structure, cell functions, and stellar evolution. But we cannot tell them how things "ought" to work out in debates about nuclear waste disposal, experiments on cloning, or proper treatments for mental illness.

The purpose of this book is to help teachers and students deal with problems of this kind. The content is focused on important questions affecting society and individuals that have their roots in scientific and technological changes over the past few decades. The format of the book

is designed to help resolve the two pedagogical problems described above. Our philosophy is that no teacher need be frightened off by the task of teaching about the social and ethical issues in science. Since it is not "correct answers" that matter anyway, teachers can concentrate on that aspect of the problem with which they are competent to deal: Helping students develop techniques for understanding and analyzing these issues. Our objective is to outline a system for studying socioscientific problems that can be developed in a science class (or any other class) and then applied in an individual's life.

The structure of the book reflects this philosophy. Each of the topics discussed in the text is approached in a five-step sequence. These five steps include the following:

An **INTRODUCTION** provides students with a brief, general background of the topic. This may include some historical information, current statistics, arguments pro and con, discussions of advantages and disadvantages, comparisons of risks and benefits, expert opinion on various aspects of the issue, and so on. The *Introduction* starts with the assumption that students know almost nothing about the issue and provides them enough background to get them thinking about the question.

The **BACKGROUND READING LIST** comes at the end of the topic, but ties closely with the *Introduction*. It will be obvious that the *Introduction* can provide only a brief, simple background for the issue at hand. Space does not permit a detailed, up-to-the-minute discussion of all aspects of the topic. Students should expect and understand that *they* are responsible for obtaining a more complete and current briefing on the topic. The *Background Reading List* is designed to help them get started on this research.

In most cases, the selections in the *Background Reading List* are taken from journals and magazines that are readily available in school and college libraries. Unfortunately, this means that some useful articles have been omitted. Also, the delay between the actual writing and publication of this book means that the *Background Reading List* is inevitably out of date. In a book of this type, that is a major difficulty. Students should be aware of both of these defects of the *Background Reading List* and understand how they can overcome them. They should become very familiar with the *Reader's Guide to Periodical Literature* and the periodical resources available in their own library. They should expect to supplement any reading they do from the *Background Reading List* with additional articles they locate themselves.

A **CASE STUDY** constitutes the core of each topic discussion. This is a real or fictional situation which students are asked to consider and reach a decision on. The case may involve a proposal to build a nuclear reactor, a piece of legislation dealing with the definition of "death," a person's dilemma over the correct product to buy, and so forth. As far as we know, there is no single, correct answer to any of these cases. In every instance, there is a variety of options with a variety of possible outcomes. Students will have to consider the background information, apply the information and opinions obtained from their background reading, analyze the advantages and disadvantages, pros and cons, risks and benefits, and come to a decision on the case.

Every *Case Study* culminates in a **BUCK STOPS HERE** question. The term used here comes from a motto reputedly kept by President Harry S Truman on his desk in the Oval Office. It reflects the notion that on every difficult issue, there comes a point at which someone has to make a decision. It is not possible to continue "passing the buck" forever. Students are encouraged in the *Student Introduction* to recognize this important feature of socioscientific controversies. *Not to decide*, in a difficult case study, is in effect to make a decision. As a result, a *Buck Stops Here* demands of each student that he or she eventually make a commitment one way or another on the issue raised in the *Case Study*. Each *Buck Stops Here* has been written in such a way as to encourage interaction among students in the class. This is desirable in that it permits individuals to express and listen to a variety of ideas and opinions on the *Case Study*. As a result of this interchange, each person has an opportunity for forming a tentative "final" judgment on the case and the group as a whole is able to reach some sort of decision about the best way to act on the controversy.

Following *The Buck Stops Here* there is a series of **ADDITIONAL QUESTIONS** on the topic. These questions encourage students to think about specific features of, or to do additional research on, the topic. The questions range from

relatively simple and factual to more complex and analytical.

A word should be said about the photographs which illustrate the text. The role of these photographs is not cosmetic (as it sometimes is in textbooks), intended merely to "brighten up" a page. They are designed to be integral parts of the teaching and learning experience. Each photograph poses an issue, raises a question, sets the stage for a discussion, or otherwise initiates student consideration of some socio-scientific problem. The teacher is encouraged to use these photos as motivators, "interest grabbers," and initiators of discussions. In fact, some may well become the basis for an entire class session or new case study.

How is this text to be used in a classroom in order to achieve the objectives around which it was designed? Every teacher will, of course, have his or her own ideas about an appropriate methodology. To us, the crucial feature is the interaction among class members that permits exchange of ideas and opinions, understanding of differing viewpoints, resolution of conflict, and other interpersonal behaviors that are characteristic of the way these issues are handled in society at large. We outline our own teaching methodology, not because it is the best or only way of handling these issues, but to further describe the way these issues can be treated in a classroom.

Our teaching situation has made it possible to divide the total class into relatively small "seminars" of about eight students each. At the beginning of the year, students are allowed to choose the topics on which they wish to work and then are assigned to seminars with other students who have selected the same topic. A date is selected and announced for each seminar topic.

Before coming to a seminar, a student is expected to read (1) the general introduction to the topic and (2) a reasonable variety of articles from the *Background Reading List*. Each student is also assigned a specific role to play in the setting provided by *The Buck Stops Here*. At the seminar, students play out the situation described, aiming at some eventual decision before the end of the class time. In these settings the instructor usually plays some neutral role, such as moderator, chair, or outside observer.

It is obvious that our situation is unusual and that most teachers will have to find other ways of arranging the interaction among students the cases require. Here are just a few possibilities:

1. **General class discussion:** All students in class can be asked to read the *Introduction* and certain selections from the *Background Reading List*. Then a general class discussion can be held on these and the class as a whole can come to some conclusion about the question raised in *The Buck Stops Here*.

2. **Demonstration seminar:** The method described for the author's class above can be carried out as a demonstration in front of the rest of the class. After the demonstration seminar has been completed, other class members may be invited to comment on the ideas, opinions, positions, and decisions expressed in the seminar.

3. **Multiple seminars:** A large class of thirty or so can be divided into three or four seminars, all meeting at the same time in a class period. The multiple seminars can all be discussing the same issue or they can be talking about different but related topics.

4. **Paper-writing:** The topics and activities associated with each might serve as subjects for papers to be written by class members. It should be apparent that this is a less desirable way of handling the topics since no interaction among students is guaranteed. If a group of students work on a single paper in the classroom or as an outside assignment, this disadvantage may be less serious, however.

What should be the role of the instructor in a teaching situation like this? As pointed out above, it is somewhat different from the traditional role in that the instructor does not have a primary responsibility to tell students correct answers. He or she may certainly want to provide background information. But the instructor's major reponsibility is to help students develop the skills of analysis and decision-making that will be necessary to do the activities. Most of us have developed these skills already, whether or not we've had a specific course in "problem-solving," "decision-making," "values clarification," or the like. The skills required included such things as being able to distinguish fact from opinion, looking for a variety of options in each case, seeing all sides of any one option, recognizing what things can be achieved in the "real" world, and so on.

In our own teaching experience, we have tried to encourage these skills by the roles we play in the seminars. We refuse to resolve conflicts themselves. One effective way of doing this is by playing "devil's advocate" in the seminar. We always look for some viewpoint or some idea that has not been expressed by a member of the seminar. We try to see that every side of an issue has been presented even if that means raising objections that we personally do not feel

comfortable with. We attempt to maintain conflict in a seminar wherever possible within the constraints that the problem remain a "real" one.

One example may help. In the seminar on the Social Responsibility of Scientists (page 203), the instructor plays the role of Dr. Stuphy. In this role, he or she answers any factual questions students may have about the research described in the Case Study. Sometimes this requires inventing answers that are reasonable whether or not they are "possible" or "correct." Beyond that, the instructor/Stuphy expresses no opinions about the implications of the research being discussed. He or she does look for issues, implications, ideas, possibilities, applications, and the like that students may not have thought about or raised. Throughout, he or she behaves in such a way as to mirror in the seminar the very real complexity of this issue as it occurs in the real world.

We acknowledge that the state of teaching about science and society issues today is quite primitive. We are eager to hear about your successes and failures with this text and to know of ideas you have for its improvement. Please let us know what you think! The form provided on page xi can be completed and sent directly to the author. We appreciate your help and interest.

We're very much interested in what you think of this book. Any comments you have or suggestions for making it better will be greatly appreciated. Your thoughts can be written on the form below and mailed directly to the author at the address on the form.

. . . . . .

TO: Dr. David E. Newton
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To the student

What role does science play in your life? How do developments in physics, chemistry, biology, and other sciences relate to major social issues our nation faces? How does research in science and technology both solve and create social problems at the same time? Perhaps you have never stopped to think about these questions. But scientific research influences your everyday life in a great many ways. For one thing, it has made your life safer, healthier, and just plain nicer in many ways. Television sets, transistor radios, new fabrics for clothes and car interiors, plastics for a great variety of uses, drugs and medicines, cosmetics, paints, and floor coverings . . . the list could go on for a long time, showing the many ways in which science has improved your life.

But not everything that science does turns out to be so wonderful. Think for a moment about some of the problems you see in the world around you: pollution, energy shortages, lack of enough minerals, questions about test-tube babies, arguments about abortion and other methods of birth control, the inhumane use of science in warfare. Again we've started another list that could get quite long.

This is not to say that scientists begin their research with the idea of causing social and ethical problems. If there are such people doing research, they are certainly very, very rare. But the fact remains that many of the products of scientific research do end up causing problems in your world. In fact, it seems that for every new great discovery that's announced, there is at least one serious problem that goes along with it.

The purpose of this book is to help you think about some of these problems. You may or may not be old enough to vote. But the kind of problems we're talking about here are ones you should start thinking about as soon as possible. One doesn't become a voter on Monday and then start thinking about the great social questions on Tuesday. It's important to start learning about these issues and finding out how they can be solved as soon as possible. We hope that no matter how old you are or how involved you are in your own community that the topics in this book will be of interest and concern to you.

You'll recognize that this book is not like most texts that you use. It does not contain a large amount of information for you to learn. The reason for that is simple. In most subjects that you study there is a lot of "correct information," lots of "right answers" that you have to master. In a chemistry course, for example, one of your main goals is to memorize the atomic theory and understand what this theory tells you about the nature of matter.

The topics in this book aren't like that. We don't know what the "right answers" to questions concerning nuclear power are. No one can tell you how the world should deal with population problems. How we should make use of techniques for behavior modification is an unsolved problem right now . . . and it may always be. Instead of trying to teach you "correct information" in this book, we will be aiming at different goals. For one thing, we simply would like to have you become aware of some of the great socioscientific issues the world faces today. We hope that by doing so you will become more interested in these questions and eager to do what you can to help solve them.

More important, however, we hope to help you develop skills in analyzing and coming to decisions on social and ethical issues in

science. Problems of this kind change rapidly. In fact, that's one reason a book of this kind is so difficult to write. A topic that may seem like a burning issue as I write this book may be of little consequence when you read it (198?). What does tend to remain constant is the way a person or a community can go about solving the problems it faces at any one time. Questions such as:

1. Why is this issue a problem today?
2. Where can I get information about this problem?
3. What are some possible solutions to this problem?
4. What are the advantages and disadvantages of each solution?
5. How can we balance the risks and benefits involved in this issue?
6. What do we do when we get different opinions from experts?
7. How can we sort out factual information from opinion on an issue?

. . . and so on . . . are relevant to nearly all social issues.

If you can become proficient at answering such questions for problems like the ones in this book, you should be able to deal more effectively with socioscientific issues that arise throughout your life. The aim of this book is not to teach you information, but to help you develop skills for solving problems.

The structure of each lesson ("topic") is designed with this in mind. First there is a general *Introduction* that gives you some factual background about the subject. It will provide some history, some current information, some possible alternatives, some viewpoints on various aspects of the questions, and so on. The introduction should help you get ready to study the problem on your own. Following the introduction you will find one or more *Case Studies*. These are concrete situations relating to the topic at hand. Some are drawn from real cases, while others have been made up by the author. The real ones are marked with an asterisk. All the others are imaginary.

The *Case Study* is the core of the lesson. It is designed to put you into a situation where you have to make a decision on the question at hand. Although it's true that there are no right answers to most socioscientific issues, that doesn't mean that decisions don't have to be made. Quite the opposite is true. Someone has to decide whether a nuclear power plant is going to be built or not. A community has to choose whether it wants a dirty, smelly paper pulp mill . . . that provides jobs . . . or a pure, clean environment . . . with lots of unemployment. A woman carrying a baby that she knows is defective has to decide whether to carry that child to term or not. As difficult as these decisions are, they have to be made one way or another. One can't say, "Oh, I just can't make up my mind what to do. I think I'll pass on this problem." The fact of the matter is that this statement itself is a decision. It says that you are willing to let someone else decide what is going to happen.

The significance of this fact is emphasized by the title of the third part of the lesson: *The Buck Stops Here*. You may have heard the old expression about "passing the buck." The phrase refers to someone who is confronted with a difficult decision that he or she does not want to make. Sometimes it's easier just to let someone else decide—to "pass the buck" to someone else. The point is that "the buck" has to stop somewhere! The phrase we use in this casebook comes from a sign that President Harry S Truman used to have on his desk in the White House. It said simply: "The Buck Stops Here." It meant that there wasn't anyone else to whom the president could defer a decision. Eventually *he* had to make up his mind and act.

In this book, we want you to feel what it's like to be in that spot. In each of the case studies, we want you to accept the responsibility for making up your mind and acting on the issues in the case. You may be unsure about the information you have. You might want to know more about the case. You might feel that you need more time. You might think that someone else is better able to make the decision. That is, there may be many reasons for you *not* to make a decision on the case. But the point of *The Buck Stops Here* section is to force you into a decision-making situation. We hope that you'll understand and accept the fact that the decision you make is not necessarily the best one, the right one, or the one you'd make a year from now. It is nothing other than the best you can do at the moment.

Following *The Buck Stops Here* section you'll find a *Background Reading List*. The introductions we've written for each topic are always incomplete and out of date. They're incomplete because no issue in this book can be discussed adequately in the space provided. They're out of date because I can't predict as I write what the best sources will be by the time you read my book. For these reasons, you should rely heavily on the background readings and on similar readings that you find for yourself. These readings should provide you

with additional information on a topic and (from the ones you locate yourself) bring you up to date on an issue. Following this student introduction you'll find a section which discusses the background reading in more detail.

You'll also find a number of photographs scattered throughout the book. The role of these photographs is not just to make the book look nicer, to "pretty-up" the text. Instead, they are intended to start you thinking about certain aspects of the issues included in this book. They pose questions, alert you to issues, start you thinking about controversies, and offer you additional ideas for new discussions and/or case studies. Your instructor may ask you to take part in a seminar or class discussion on the issues raised in these photographs or to develop the issues suggested by them in some other way.

Finally, we strongly encourage you to talk about issues in this book with other students. In a democracy, questions like those included here are never decided by a single individual sitting alone in an empty room. They are resolved as groups of people with differing information, differing viewpoints, and differing vested interests come together and talk about their differences. There is sharing of information, exchange of ideas, analysis of each other's positions. . . and horse-trading, arguing, and shouting. Out of that process, in the best of situations, comes a decision as to what to do about a particular issue.

We believe that students should be involved in the same process. For that reason, every case study in this book expects that you will meet with other students and exchange ideas. The role-playing opportunities you find are nothing other than gimmicks to get you working with other people on a particular topic. Your instructor will probably have additional ideas about how best to accomplish this objective in your own classroom setting.

We're very much interested in what you think of this book. Any comments you have or suggestions for making it better will be greatly appreciated. Your thoughts can be written on the form below and mailed directly to the author at the address on the form.

. . . . . .

TO: Dr. David E. Newton
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A note about the background readings

Although suggested readings are listed for every topic, students are expected to do additional reading in articles they find. Certain magazines, journals, and sections of periodicals are useful for particular subjects. The following discussion will introduce you to the most important of these.

Perhaps the most important sources of news and comment on social issues in science are *Science* magazine and *Science News*. *Science* is the official journal of the American Association for the Advancement of Science, and is written at a somewhat more advanced level than is *Science News*. The latter publication is intended to report current news in science for the layperson. "News and Comment" is the section of primary interest in *Science* although "Research News" and feature articles may include relevant information. The "Letters" and editorial columns in *Science* (as in most journals) are almost always fascinating, often carrying a variety of opinions about ongoing issues such as nuclear power, sociobiology, and the place of science in government. *Science and Government Reports* is an enormously valuable research tool and is edited by Daniel Greenberg, arguably the nation's keenest observer of science/government issues. Unfortunately, it is not readily accessible for many students.

A number of periodicals discuss science/society issues when and as they arise in the context of their own special interest. When using these references, it is valuable to keep in mind the particular bias the periodical may have. A sample of these follows:

Business:
Forbes, Fortune, Business Week, The Nation's Business

Religion:
America (Roman Catholic), *Commonweal* (Roman Catholic), *The Christian Century* (Protestant), *Christianity Today* (Protestant), *Commentary* (Jewish)

Conservative:
National Review, The Conservative Quarterly, Reader's Digest

Ultra-Conservative:
The American Mercury (far right)

Liberal:
The Nation, The New Republic

Ultra-Liberal:
The Progressive, Science for the People (far left)

Future Studies:
The Futurist, Future Studies

Among newspapers, *The New York Times* is probably the only paper regularly and widely available to students. It is regarded by many as the most complete and reliable source of news on a daily basis although, in fact, it is certainly not free of its own prejudices and biases in its selection and reporting of news. *The Wall Street Journal* and *The Christian Science Monitor* are two other useful papers with national circulation.

In recent years, a number of magazines have arisen with the aim of explaining science, technology, and related social and ethical issues to the general public. The quality of these varies, depending to some degree on the magazine's tendency to sensationalize discoveries, inventions, and issues. A glossy format and/or a wide circulation is no guarantee that the journal is a good resource, to which the demise, in 1982, of *SciQuest* (formerly

Chemistry) attests. This little monthly was, during its short lifetime, a readable introduction to modern science and issues related to it. Of the "pop-sci" journals in existence at the time of this writing, those we personally recommend, in order of preference, are:

Science '82 (title changes with year)

Discover

Science Digest

Scientific American is probably the "granddaddy" of the pop-sci periodical, having been in the business of explaining science since 1845. Articles in *Scientific American* deal almost entirely with technical subjects, however, and are written at a high degree of difficulty. Except for brief commentaries in the "Science and the Citizen" column, this journal seldom contains information of value to this text.

Most fields of science publish one or more specialized journals. These journals tend to concentrate on technical subjects of little interest to the general student. They may, however, provide a forum for discussions of social, political, economic, and ethical issues. Editorial columns, the "letters to the editor" section, or special features in these journals may be exceedingly helpful. A few examples include:

Chemical & Engineering News: See especially the "Letters" columns, "Books" column, the editorials, and the regular feature called "Government Concentrates."

Chemical Week: See the regular feature called "Washington Newsletter."

Bioscience: See especially the "Features and News" section.

Physics Today: See the "State and Society" section.

A somewhat esoteric, but very interesting resource is *The Hastings Center Review*. The Hastings Center (360 Broadway, Hastings-on-Hudson, NY, 10706) is an institute created for the analysis and discussion of social and ethical issues in biology. The articles are fairly difficult and the *Review* is not easily located, but there is no better source for "state-of-the-art" thinking in bioethics.

Environmental issues are treated frequently and effectively by four journals: *Audubon, Environment, National Wildlife*, and *Living Wilderness*. Each contains articles covering both technical and social/ethical aspects of subjects such as endangered species, land use, pollution, and waste problems in a readable format. Of the four, *Environment* tends to have the widest perspective, dealing with many science-society issues not strictly related to the environment. A number of other environment-oriented magazines, such as *National Parks and Conservation, Field and Stream,* and *Outdoor Life* are also useful sources, but may be more difficult to locate.

For questions on nuclear power, by far the best reference is *Bulletin of the Atomic Scientists*. It has no equal in dealing with the social, political, economic, and ethical issues surrounding the use of nuclear power. It also contains articles on the role of science in politics, the social responsibilities of scientists, and other social issues in science.

Newsletters of the Program on Public Conceptions of Science have been published by the Harvard University Program on Science, Technology, and Public Policy, later the *Newsletter on Science, Technology, and Human Values*. You will be very fortunate indeed if you can locate past issues of this newsletter. They contain by far the best bibliography of books and articles dealing with the social implications of science and technology. (Aiken Computation Laboratory 231, Harvard University, Cambridge, MA 02138)

Please note that a number of older articles (ten or more years older) occur in the *Background Reading Lists*. Normally, it is probably better to use articles as recent as possible in preparing for these cases. But there are times when older references may be helpful. For example, there was a great deal of soul-searching about the role of science in society during the Vietnam conflict of the 1960s. While the specifics in articles written at that time may have changed, many of the issues are still being debated. We suggest that you use these older articles for whatever current relevance they may have and also as models of the kind of articles you should look for in the current literature.

Books are never included in the *Background Reading Lists*. There are two reasons for this omission. First, most students will not be able to read a complete book in preparation for a single case study in this book. Second, the availability of specific books in libraries across the country is less likely than the availability of specific journals.

Nonetheless, many books have been written on nearly all the topics included here. We recommend that those students interested in books ask their instructor or the librarian, refer to the *Book Review Digest*, or become familiar with some standard book review columns. In the last case, the reviews themselves can be good

introductions to and discussions of social and ethical issues in science. Our personal choices in book reviews are the regular columns in *Science* and in *Chemical and Engineering News*.

A few books worth knowing about cover a number of the topics discussed in *Part One* and *Part Two*. Among these are:

Beauchamp, Tom L., and LeRoy Walters, eds. *Contemporary Issues in Bioethics*. Encino, Calif.: Dickenson Publishing Company, Inc., 1978. *A text dealing with such issues as life and death, human experimentation, behavior modification, and medical ethics.*

Ellison, Craig W., ed. *Modifying Man: Implications and Ethics*. Washington: University Press of America, 1977. *Includes sections on genetic engineering and electrochemical modification.*

Hunt, Robert, and John Arras, eds. *Ethical Issues in Modern Medicine*. Palo Alto, Calif.: Mayfield Publishing Co., 1977. *Chapters include genetics, abortion, euthanasia, informed consent, behavioral control, psychosurgery, and medical ethics.*

Maddox, John. *The Doomsday Syndrome*. New York: McGraw-Hill, 1972. *A famous book that suggests that critics of the late 1960s and early 1970s were being too harsh in their criticism of the misuses of science.*

Veatch, Robert M. *Death, Dying, and the Biological Revolution*. New Haven, Conn.: Yale University Press, 1976. *A critical survey of the medical, ethical, and legal aspects of death and dying.*

Wertz, Richard W., ed. *Readings on Ethical and Social Issues in Biomedicine*. Englewood Cliffs, N.J.: Prentice-Hall, 1973. *A series of articles by scientists, lawyers, historians, and physicians on this topic.*

Wojcik, Jan. *Muted Consent: A Casebook in Modern Medical Ethics*. West Lafayette, Ind.: Purdue University Press, 1978. *A "primer for non-specialists in medical ethics," focusing on topics such as genetic counseling, abortion, behavior modification, treatment of the dying, and genetic engineering.*

Finally, there are some excellent books that deal with the very complicated interrelationships between science, scientists, politics, and government. They will be especially helpful in developing a general understanding of the history and current issues in the interaction of science with politics. At least some reading in these resources will be helpful in preparation for the topics that make up *Part Three* of this text.

Allen, Jonathan, ed. *March 4: Scientists, Students, and Society*. Cambridge: MIT Press, 1970. *A record of events and discussions at MIT during the "strike" of scientists there on March 3 and 4, 1969. Issues are those of the roles of science and government.*

Ames, Mary E. *Outcome Uncertain—Science and the Political Process*. Washington: Communications Press, Inc., 1978. *Case histories on the relationship of science to politics, ethics, and the social sciences.*

Barber, Bernard. *Science and the Social Order*. New York: The Free Press, 1952. *A pioneering analysis of the social role of science by one of the nation's leading sociologists of science.*

_____, and Walter Hirsch. *The Sociology of Science*. New York: The Free Press, 1962. *Still one of the standard works on the social characteristics of science.*

Bernal, J.D. *The Social Function of Science*. Cambridge: MIT Press, 1967. *A reprint of a classic treatise on the place of science in society, first written in England in the late 1930s.*

Brooks, Harvey. *The Government of Science*. Cambridge: MIT Press, 1968. *An important basic work on such issues as the planning of science, federal support for science, technology and the economy, and so on.*

Brown, Martin, ed. *The Social Responsibility of the Scientist*. New York: The Free Press, 1971. *A series of lectures presented by an interdisciplinary group at the University of California in 1969-70.*

de Nevers, Noel, ed. *Technology and Society*. Reading, Mass.: Addison-Wesley Publishing Company, 1972. *Readings and assignments for a course on technology and its impact on society.*

Dorf, R.C. *Technology, Society, and Man*. San Francisco: Boyd & Fraser Publishing Company, 1974. *A text that concentrates on the nature of technology and its involvement with the rest of society.*

Dupree, A. Hunter. *Science in the Federal Government*. Cambridge: The Belknap Press of

the Harvard University Press, 1957. *An historical study that provides valuable background information and perspective on contemporary issues.*

Dupré, J. Stefan, and Sanford Lakoff. *Science and the Nation*. Englewood Cliffs, N.J.: Prentice-Hall, 1962. *A scholarly study of the "policy and politics" of American science.*

Fischer, Robert B. *Science, Man and Society*. Philadelphia: W.B. Saunders Company, 1971. *A small, but thorough, review of the nature of science, its role in education, and its interrelationships with the rest of society.*

Greenberg, Daniel S. *The Politics of Pure Science*. New York: The New American Library, 1967. *A masterpiece by perhaps the best contemporary observer on the role of science in government.*

Haberer, Joseph. *Politics and the Community of Science*. New York: Van Nostrand Reinhold Co., 1969. *An examination of "modern science in the light of some fundamental political and moral problems with which its rise to a major institution of society has confronted us."*

Lakoff, Sanford A., ed. *Knowledge and Power: Essays in Science and Government*. New York: The Free Press, 1968. *An especially good selection of essays on the interaction of science and government.*

Lapp, Ralph E. *The New Priesthood: The Scientific Elite and the Uses of Power*. New York: Harper and Row, 1965. *How scientists have become involved with politics and government since World War II, and what this has meant for both parties.*

Price, Don K. *Government and Science*. New York: Oxford University Press, 1968. *A study of ". . . all aspects of the increasingly important relationship between science and government."*

Primack, Joel, and Frank von Hippel. *Advice and Dissent: Scientists in Political Arena*. New York: Basic Books, 1974. *A series of case studies on the involvement of scientists in public policy, both as insiders and outsiders.*

Schooler, Dean, Jr. *Science, Scientists, and Public Policy*. New York: The Free Press, 1971. *A scholarly study of the role of science and scientists in public policy in the post-war years, in the 1970s, and in the year 2000.*

Schroeer, Dietrich. *Physics and Its Fifth Dimension: Society*. Reading, Mass.: Addison-Wesley Publishing Company, 1972. *A marvelous paperback that synthesizes interesting and useful technical information about science with some important connections between it and the rest of society.*

Shapley, Willis. *Research and Development in the Federal Budget: FY 1977*. Washington: American Association for the Advancement of Science, 1976. *Although somewhat dated, this is an excellent explanation of the process by which the budget is written and how social, political, and economic factors affect the way scientific research and development are funded.*

Strickland, Donald A. *Scientists in Politics (The Atomic Scientists Movement, 1945-56)*. West Lafayette, Ind.: Purdue University Press, 1968. *An historical account of the first large-scale involvement of scientists in politics.*

Watson, James D. *The Double Helix*. New York: Atheneum Press, 1968. *Perhaps the most famous and one of the most interesting books ever written about the way "science really works."*

Weinberg, Alvin M. *Reflections on Big Science*. Cambridge, Mass.: MIT Press, 1967. *The term "Big Science" is used to describe the dramatically new kind of scientific endeavour that has arisen primarily since World War II. This book talks about some of the implications of the change science has undergone during this period.*

Wiesner, Jerome B. *Where Science and Politics Meet*. New York: McGraw-Hill, 1965. *Some observations by a former science advisor to the president.*

A good general reference on environmental issues is the annual report of the Council on Environmental Quality, issued as *Environmental Quality of 198X*. For example, *Environmental Quality 1984* is the Council's 15th annual.

part one

Issues from the biological sciences

Topic one
A matter of life and death: The prolongation of human life

Introduction

The worst pestilence to strike the United States in the second half of the twentieth century is modern medicine! That statement is, of course, not at all true. But it may have some shock value in getting you to think about the one aspect of our modern lives which is probably most widely admired and respected of all. There certainly can be no question about the boundless miracles that medical research has brought us in the last century. Until recently, there were no cures for diseases like polio, tuberculosis, and syphillis. Victims simply had to endure them. These and many other afflictions are now cured as a matter of routine. The repair of limbs, transplantation of organs, and treatment of genetic defects were once scarcely imagined. All are now described almost daily in the newspapers. Human life itself was once a gift to be enjoyed for only thirty or forty years on the average. It has now been stretched to a full three-score and ten.

But, if we have learned anything at all about the gifts of science in the last two decades, it is that they never come freely. For each new pleasure or convenience we receive, there is a price: increased pollution from more automobiles, a loss of natural resources from endless new modern appliances, increasing unemployment from the invasion of computers, and so on. And thus it is with modern medicine too. Imagine the price we pay for prevention and cure of disease, and lengthened life span: overpopulation, "geriatric" pollution, and unnecessarily prolonged life. Overpopulation results when improved medical care reduces both death rates and infant mortality rates. Both of these combine to increase the rate of population growth. Some observers have said that the effect of improved health care in India has been a catastrophe. Babies who would once have died before their first birthday, now survive to share the poverty of India's growing millions!

"Geriatric pollution" is a problem in affluent countries like the United States. Here, the problem faced by the elderly is not likely to be starvation, but neglect. Society has not yet learned how to live with the elderly. Our splintered, mobile families find it hard to fit grandma and grandpa into their daily routines. Besides, the face of age is not welcome in a society that glorifies youth. We hide from the "problem" by sending our "senior citizens" (we're even afraid to call them "old") out of sight: to nursing homes, hospitals, and retirement communities. There their presence will not embarrass or frighten us. (See questions 5-9 on page 5.)

Neither overpopulation nor the problem of the elderly has really been *caused* by medical science. But they have been compounded by the success of medical research. For neither problem has there been much progress towards—or even thought about—a solution. Some ask, indeed, if there can even be such a thing as a "solution" to these problems. Our concern here is with the third one of these unexpected fruits of our successful medical progress: the treatment of patients at death's door.

The question of how we should deal with the incurably ill is not a new one. What should be done with the woman in the last stages of terminal cancer, her every waking moment an agony of pain? Or how do we "treat" the victim of encephalitis ("sleeping sickness") when his brain is damaged so severely by fever that he can never be more than a "human vegetable"? In such totally hopeless cases, is not the termination of human life a greater blessing

than the continuance of a hopeless situation? Or is that even a decision for humans to make?

But euthanasia (mercy killing) is not the subject of this case either. What we do invite you to think about is the increasingly common practice of maintaining life in patients for whom there is no apparent hope for survival. It is no longer uncommon to find in our hospital men and women suffering from some incurable disease or from the inevitably fatal consequences of an accident, being kept alive by the heroic efforts of medical science. Anyone who has seen a patient poised at the threshhold of death, held back only by the ingenuity of doctors and the miracles of medical machines, cannot be but horrified and awed at once. That research has come so far as to make it possible for humans to hang so tenaciously to life can be nothing short of amazing: artificial lungs to assist breathing; artificial kidneys to help clear the body of wastes; networks of tubes and pipes to help the patient ingest food; and so on. So many of the bodily functions are replaced by machines that it's no longer entirely clear when the patient is surviving "on his or her own."

Does this represent "progress"? Is this obstinate desire to hang on to life a favor to the patient? To some people, the answer is an easy "yes!" Anything we can do to prolong and maintain human life is good. But not everyone agrees with this view. What point is there, they ask, in stretching out a life for a few more hours, a few more days, or, at best, a few more weeks when the patient is likely not even to be conscious! The psychological stress on relatives and friends is enormous, and the financial cost may be catastrophic. Why not let nature take its course and bring death when the time has come?

Ten years ago the medical profession was enthusiastic about using computers to help diagnose medical problems in patients. Today, some people are arguing that physicians should be **required** *to use computers in diagnosing difficult problems. What would be the logic behind a requirement like that? Would you support a state law for a requirement such as this? Why or why not?*

Case Study #1: The Case of Clinton John Broderick IV

Clinton John Broderick IV is presently at Hepplewhite Memorial Hospital, suffering from acute iliatory inflammatory disturbitis (AID). Mr. Broderick, seventy-two years of age, has been confined to Hepplewhite for eighteen months during which time his condition has become increasingly severe. There is no

known cure for AID. Patients tend to deteriorate slowly after its onset, usually late in life. Life expectancy ranges from two to about twenty years after first appearance of the disease. AID is characterized by gradual weakening of the limbs, loss of strength in the muscles, loss of eyesight and coordination, impaired mental function, and general disability.

Mr. Broderick's case has been somewhat unusual in that he has experienced alternate periods of rapid deterioration and temporary remission. Although there appears to be no hope for Mr. Broderick's recovery, the medical staff at Hepplewhite is making every effort to sustain his life and make him as comfortable as possible. Frequent minor surgery to clear the adiposis has been performed, and occasional sessions on the artificial kidney have become necessary. Mr. Broderick has been comatose for the last two months and has not spoken coherently for almost four months.

Mr. Broderick's three children have recently been discussing the advisability of maintaining their father's life in his present condition. Ambrose, the eldest, is especially concerned about the enormous expense of his father's medical care. Hospital bills have been mounting at the rate of about $3,000 per month and even the substantial assets of CJB Chocolate Termites, the family business, have begun to feel the strain of this expense. Another two years would bring the firm to bankruptcy.

Elsa, the only daughter, is adamant in her insistence on the maintenance of her father's life, at whatever cost and by whatever means. Research sponsored by the AID Foundation has produced some promising leads, and some scientists predict the finding of a complete cure within two years. Father must be kept alive if at all possible in the hope that that cure will be found, she believes.

Ardnath, the third child, points out the "uselessness" and misery of their father's present life. For all practical purposes, he has been dead for at least eighteen months. While there remains a chance in theory that Mr. Broderick will recover, there is no reason to believe that he will ever again be able to function in a "human" way.

What decision should be made regarding the maintenance of Clinton John Broderick IV's life?

The Buck Stops Here

Let each student play the role of one of Clinton John Broderick's children, presenting his or her opinion to the class. Then let three class members debate among themselves the question of whether Mr. Broderick should continue to be maintained by current medical survival methods.

Additional Questions

1. How would it be possible to "allow" Mr. Broderick to die? Would you regard such an act as a form of murder? Why or why not? How does the law regard it?

2. What role should government (state, local, or national) or private foundations play in the process of maintaining the incurably ill? Do they have any legal or moral or political or social or financial or . . . any other kind of responsibility in cases of this type?

3. Is the above case an example of euthanasia or not? Explain your answer. Are decisions on "letting people die" and on "mercy killing" essentially the same or different types of decisions? Explain.

4. Since doctors generally have greater expertise in medical matters and are less involved with patients emotionally than are family members, should they (doctors) be given the legal right to overrule family decisions on keeping the incurably ill alive? Why or why not?

5. The introduction to this case raises "problems" of the elderly. In what sense are old people a "problem" to our society? Discuss briefly each reason you list.

6. Find out how other societies feel about the elderly. In what ways do they treat old people differently from the way we do? In what ways are we "better" to the elderly? In what ways "not as good?"

7. What special qualities do older people have to contribute to any society? Examine the list you've just made. Does it apply to the United States in the 1980s? Why or why not?

8. In what *specific* ways do the media affect the way we think about older people? Give some specific examples from newspapers and magazines, radio and TV, and film.

9. How do older people feel about their place in this society? The best way to answer this question is to interview some older people in your community. List the answers they give to this question.

Case Study #2: The Case of Clinton John Broderick V

Clinton John Broderick V is presently at Hepplewhite Memorial Hospital, suffering from acute iliatory laminitis (AIL). Clinton, seven years of age, has been confined to Hepplewhite for eighteen months, during which time his condition has become increasingly severe. There is no known cure for AIL, and patients tend to deteriorate slowly after its onset, usually within the first ten years of life. Life expectancy ranges from two to about twenty years after first appearance of the disease, which is characterized by gradual weakening of the limbs, loss of strength in the muscles, loss of eyesight and coordination, impaired mental function, and general disability.

Clinton's case has been somewhat unusual in that he has experienced alternate periods of rapid deterioration and temporary remission. Although there appears to be no hope of Clinton's recovery, the medical staff at Hepplewhite is making every effort to sustain his life and make him as comfortable as possible. Frequent minor surgery to clear the adiposis has been performed, and occasional sessions on the artificial kidney have become necessary. Clinton has been comatose for the last two months and has not spoken coherently for almost four months.

Specialists from the AIL Foundation have examined Clinton and have unanimously agreed that there is no reason whatsoever to maintain any long-term hopes for recovery. Research has produced some promising leads in the direction of a cure for AIL, but there seems no reason to believe that a breakthrough will come for at least two years. Clinton is not at all likely to last long enough to benefit from any such cure. Even if remission could be obtained, doctors believe that some important permanent effects, notably loss of eyesight, hearing, and most mental functions are already certain. Nonetheless, doctors and Clinton's parents strongly agree that every available effort should be expended in keeping Clinton alive, and almost $20,000 in donations has already been received from individuals all over the country.

The Buck Stops Here

Clinton's parents understand how much you, his favorite relative, care about the child. They've come to you to ask your opinion about their decision. How will you answer them?

Additional Questions

1. Is this problem the same as or different from Case Study #1? If you say there are differences, point out what they are.

2. Would you make the same kind of decision in Case Study #2 as you did in Case Study #1? Why or why not?

3. Reread Questions 1-4 in Case Study #1 and decide, in light of this case, whether your answers would be any different than they were before. Explain any changes that you might make.

Background Reading List

Cicirelli, Victor G. "The Impact of Terminal Cancer on Family Members." *USA Today*, March, 1981, pp. 49-51. *What are some of the effects of a terminal disease on those related to the patient?*

Collins, Evan R. "The Right to Choose Life or Death." *USA Today*, November 1984, pp. 34-37. *Legal issues in treating the terminally ill.*

Conley, John J. "Baby Jane Doe: The Ethical Issues." *America*, February 11, 1984, pp. 84-89. *Review and analysis of a now-famous case of a hopelessly ill infant.*

Culliton, Barbara J. "The Haemmerli Affair: Is Passive Euthanasia Murder?" *Science*, December 26, 1975, pp. 1271-1275. *A prominent Swiss physician has been accused of murder in the deaths of patients for whom he refuses to provide extraordinary measures to prolong their lives.*

"Death Agonies." *Time*, January 9, 1984, p. 44. *Story of two cases requiring the decision as to whether or not to prolong an incurably ill patient's life.*

Javits, Jacob K. "When Should Doctors Let a Patient Die? " *Discover*, August 1984, pp. 30-31. *An eloquent statement by a former senator from New York state, who died in March of 1986 from an incurable disease.*

Kolata, Gina Bari. "Withholding Medical Treatment." *Science*, August 31, 1979, pp. 882-885. *Discussion of a Massachusetts court decision on the treatment of terminally ill patients.*

McCormick, Richard A. "Legislation and the Living Will." *America*, March 12, 1977, pp. 210-213. *Some arguments against California's "Right-to-die" law.*

Oden, Thomas C. "A Cautious View of Treatment Termination."
Vaux, Kenneth. "Beyond This Place: Moral-Spiritual Reflections on the Quinlan Case." *The Christian Century*, January 21, 1976, pp. 40-47. *A pair of articles dealing with religious issues involved in the*

life/death problems posed by the Karen Ann Quinlan case. See also the responses in April 7, 1976, pp. 341-342.

Paris, John J. "Brother Fox, the Courts, and Death with Dignity." *America*, November 8, 1980, pp. 282-285. *Ethical issues surrounding the decision to remove an eighty-three-year old Catholic brother from all life-support systems.*

_____, and Andrew Varga. "Care of the Hopelessly Ill." *America*, September 22, 1984, pp. 141-144. *Views on this question from the standpoint of the medical profession and the Catholic church.*

"The Right to Die Controversy." *Changing Times*, July 1984, pp. 73-74. *Examples of cases in which patients have been kept alive under very difficult circumstances.*

Ross, Val. "The 'Mercy' Killers." *MacLean's*, November 21, 1983, pp. 24-29. *Legal and ethical questions of both active and passive euthanasia in Canada.*

Rubin, Harold. "The Right to Die Decently." *Nation*, February 4, 1978, pp. 114-116. *An explanation of how California's Natural Death Act works with some data on how the act has been received by the state's physicians.*

Stinson, Robert and Peggy. "On the Death of a Baby." *The Atlantic*, July 1979, pp. 64-66. *A description of efforts to keep alive a two-pound premature baby as a "case study in the limits and excesses of modern medicine."*

Williams, Roger M. "This Way Out." *Omni*, August 1981, pp. 45-47+. *A report on the growing movement of those who believe terminally ill people should be allowed to choose the circumstances under which they die.*

"Dr. X." "I Pulled the Plug." *Family Health*, July 1980, pp. 30-33. *A physician's account of how he treated a young child very seriously injured in an accident.*

(Also check the *Background Reading List* for Topic 10: DEFINING DEATH, page 62, for additional related readings.)

Topic two
The "right" to life: Abortion

Introduction

How do people make up their minds about the "right" thing to do? Each of us is brought up under a certain moral code, usually imposed by our parents, telling us what is "good," "true," and "right" versus what is "evil," "false," and "wrong." Of course, the moral code imposed in any one house is likely to be slightly different from the one learned next door, across town, or in another city. But, generally speaking, there is a common understanding among all the people of a particular culture as to what is "right" and what is "wrong." In our country, for example, most people would agree (in principle, at least) that it is "right" to help someone who is injured or poor or orphaned, and that it is "wrong" to steal or to murder.

Not all decisions are as clear-cut as these examples, however. Is it wrong to go to war and kill other humans to protect your own land? Most Americans would say not. But a sizeable minority believes that *all* killing (including the kind just described) is wrong. The problem is even more difficult if you believe the war itself is immoral, illegal, or just plain wrong, as in the case of the Vietnam War. And so, there are "gray" areas in morality, areas in which there is substantial disagreement about "right" and "wrong." One reason they exist is that opinions change. Technology changes, social conditions change, economic conditions change, and even religions change . . . so why shouldn't morals and ethics change too?

One moral issue over which there is a good deal of controversy right now is abortion. Abortion is the process by which a human fetus is expelled from the uterus before it is ready to be born. Historically, the climate of opinion in the United States has run strongly against the practice of abortion. There are many

reasons that abortions were illegal in all of our states until quite recently. One major influence was the teaching of organized religions, the Roman Catholic Church, in particular. Even today, the termination of pregnancy before full term for any reason whatsoever is contrary to Catholic doctrine.

Our vast natural resources and extensive open lands may have been another factor in our historical view of abortion. Large families were not only an asset to individual sets of parents, but to the nation as a whole. Having many children was a "patriotic" thing to do. Thus, early in our history the social climate favored having many children. Abortions were considered permissible, even among "liberal" thinkers, only under extreme medical conditions. A serious threat to the mother's life because of childbirth was one of the few such examples. In general, the most liberal laws adopted by the states permitted abortions under one of only three conditions: pregnancy due to rape, the danger of malformed children, and a clear-cut threat to the life of the mother.

American attitudes toward abortion do not necessarily coincide with those of people in other parts of the world. In many cultures, birth control methods are inadequate or nonexistent or information on such methods is not easily available to all people. In those cultures, abortion may be a traditional and common method of limiting family size. The practice occasionally exists side by side in countries where religious teachings oppose its existence. For example, Italy is a strongly Roman Catholic nation. Yet, it has also had a high rate of abortions. In 1981, Italians voted for the second time in three years, two to one, to retain legal abortion as a national policy. As a result, citizens of some other countries find Americans' attitudes toward abortion mystifying.

In the second half of the twentieth century, American attitudes and laws about abortion have undergone a significant change. Public opinion polls over the last two decades have shown a growing support for the concept that abortion is a woman's personal decision. Anywhere from 50 percent to 75 percent of those polled oppose legislation which would regulate a woman's personal decisions about abortion.

In 1973, the law of the land concerning abortion underwent a sudden and dramatic change. The Supreme Court ruled that states could pass *no laws* regulating abortion during the first three months of pregnancy. A state *could* pass laws pertaining to the second trimester (three-month period) in order to guarantee that abortion procedures used by physicians were safe for the pregnant woman. Only during the final trimester were the states allowed to pass legislation regulating abortion. The court's action immediately voided all state laws on abortion including the recently enacted liberal abortion laws of New York, Hawaii, Washington, and Alaska.

What are the conditions which have brought about this apparent change in Americans' attitudes toward abortion? For one thing, medical techniques have improved to the point that abortions represent very little threat to the woman's life. The death rate from illegal abortions is relatively high (perhaps as high as fifty per 100,000 live births). In contrast, properly performed legal abortions are about as safe as tonsillectomies. One study has shown that in the two-year period, 1970 and 1971, only six deaths resulted from 73,000 legal abortions performed in sixty-six medical institutions. In fact, from the mother's standpoint, a legal abortion is actually safer than normal childbirth.

An additional factor may be our greater concern with population growth. We certainly are not as yet an "overpopulated" nation. In addition, we have a number of relatively safe contraceptive techniques. Still many parents now see abortion as one possible means of limiting family size. The decline in birth rate because of abortions is likely to be small (about 1.5 per 1,000 according to one estimate). But it is a significant factor in reducing *illegitimate* births. The first year of New York's new abortion law, for example, saw the first decline in illegitimate births in more than ten years.

Yet another factor—and perhaps the most powerful one of all—is the growth of women's consciousness of their own rights ("women's liberation"). The argument offered is that a woman should have the right to decide what happens to her own body. That includes *choosing* whether or not to have a baby. The state has no constitutional right, according to this line of reasoning, to impose its will on a private medical matter such as childbirth.

The 1973 Supreme Court decision was a dramatic victory for the pro-abortion movement in this nation. Most members of that movement felt the war over abortion was ended, the victory secure. A decade later, it's apparent that this is not the case. Anti-abortion groups rallied forces and renewed the fight in the courts, in legislatures, and among the general public. They have been very successful at all levels. A number of state legislatures have passed laws prohibiting or limiting abortions. The fact that most such laws are generally declared unconstitutional has not prevented states from passing nearly the same laws all over again. Using another approach, federal and (some) state legislators have prohibited the use of public funds to

finance abortions. This policy does not conflict with the 1973 decision: abortions are still legal. But the practical effect is to make it difficult or impossible for poor women to obtain legal abortions. Women with financial resources will still be able to obtain abortions, as they probably always have. Poor women will once more have to seek illegal abortions. The Supreme Court has ruled that legislation of this kind is permissible.

The fight over abortion may be the most explosive and bitter issue in the United States today. Laws, public attitudes, and specific questions change rapidly. The background we sketch today may have changed significantly by the time you read this . . . which makes it essential for you to collect the very latest information on this issue. But it seems likely that one theme will be with us for a number of years: revising the Constitution to deal with abortion.

Those opposed to abortion see two routes to having their view declared the law of the land: (1) getting a new ruling from the Supreme Court that prohibits all abortions or (2) passing a constitutional amendment making all abortions illegal. Realizing the difficulties in getting the Supreme Court to change its mind, anti-abortionists have proposed a variety of "human life amendments." A common theme of these amendments has been to declare that human life legally begins at conception. The uncertainty about this question—the point at which a fetus is actually "alive"—was a major issue in the 1973 Supreme Court case. At that time, Justice Blackmun wrote that "a fetus is not a human and, therefore, not subject to the equal protection clause." The aim of recent anti-abortionist legislation has been to change that view and to have declared that human life begins at the moment the sperm penetrates the egg. This definition of life would provide anti-abortionists with a sound legal position on which to hang their case. If life *does* begin at conception, the fertilized ovum is immediately protected by the Fourteenth Amendment to the Constitution and abortion becomes (legally) murder. For anti-abortionists, this would provide a firm solution to this issue which would be difficult to change in the future.

Case Study:
An Anti-Abortion Amendment

After nearly a decade of confusion, hesitancy, and inaction, pro-abortionists have decided to take a strong and aggressive stand on their philosophy. By the early 1980s they are in agreement with the anti-abortionists on one fundamental point: Anything short of a constitutional amendment is unlikely to offer a "final solution" to the question of abortion. As a result, Representative Harriet A. Waldo and Senator Augustus Oxley Bronson have jointly sponsored a proposed constitutional amendment dealing with the topic. The text of the amendment reads as follows:

> "No law shall be enacted prohibiting the right of a woman to choose medical services for the purpose of abortion at any time that she shall choose."

In effect, the amendment makes the matter of abortion a concern of a woman and her doctor alone. It prohibits any governmental agency at any level from legislating on the subject in any way whatsoever.

The Buck Stops Here

As a member of the United States Congress, you will be asked to vote on a "sense of the Congress" motion concerning this proposed amendment. Decide whether you would favor or oppose the motion. You should prepare a series of statements that supports the position you finally decide on.

Additional Questions

1. At what point does a fetus become a "living human being?" Offer as much scientific evidence as you can find to support your decision.

2. What are the essential biological changes which take place in the fetus during each of the three trimesters of pregnancy? How are these changes related to the advisability or desirability of abortion in each trimester?

3. Why would the Supreme Court, in its January 1973 decision, prohibit laws against abortions *only* in the first two trimesters?

4. "Anti-abortion laws are essentially racist and class-biased because, as a matter of fact, the richer a woman is, the more easily she can obtain an illegal abortion anyway. Thus, abortions have been and always will be available to women of the upper class and the upper middle class." Comment on this proposition.

5. Suppose that the majority of members in the state legislature favor the *prohibition* of abortion. Do they have the right to impose their view (by passing legislation) on *all* citizens of the state? In general, *when* does the government have the right to legislate morals and when does it not?

6. Assume for the moment that the fetus is *not* defined as a living human being. It does, however, have the potential for life. Is it "right" to destroy (by abortion) this potential life?

7. How effective do you think abortion would be as a means of population control? Explain your answer.

8. Do you agree with the idea that women should have the right to do with their bodies as they choose? If not, explain why not. If so, does this necessarily imply the legalization of abortion? Why or why not?

9. Suppose you were asked to appear before the congressional committee studying the Waldo-Bronson proposed constitutional amendment. Prepare and deliver a statement which explains why you would support or oppose that amendment.

10. The status of abortion legislation changes rapidly. Find out what the current *legal* status of abortion is in your state. This includes not only any legislation on abortion itself, but also laws and regulations on funding and related issues.

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Topic three
Handbags, fur coats, and profits: Endangered species

Introduction

The world will be no worse off when the last California condor is gone. After all, there are about 8,600 species of birds, so what possible difference could it make if only one species should disappear from the earth?

That argument *might* be true for certain obscure forms of animal life. But at what point is it *no longer* true? If we can do without mosquitoes and tsetse flies, can we also get along without crickets and ants and garter snakes and alligators and wolves and elephants and white rhinos? The style and pace of modern life is such that many animal species are now threatened with extinction. The United States Department of the Interior has declared that there are now thirty-three species of mammals, sixty-seven species of birds, sixteen species of reptiles and amphibians, and twenty-nine species of fish on the "endangered" list in this country alone. The world list is much larger. It includes such animals as the Tasmanian wolf, the Australian banded anteater, the Arabian oryx, and the Asiatic cheetah. In almost every case it has been a single animal—*Homo sapiens*—that is responsible for the threatened extinction. There are probably literally hundreds or even thousands of species that may have to be sacrificed so that humans can continue to live the kind of life they have established for themselves on earth.

Threats to animal life from human activities come from many directions and in different forms. Leopard, sable, mink, and panther skins have long been highly cherished by women for fur coats, capes, and stoles. The demand for alligator skin for purses and shoes has endangered a form of animal life that has otherwise survived for millions of years. The annual slaughter

A radiotransmitter is being implanted in the body of this grizzly bear. The device will allow biologists to monitor the movement of this member of an endangered species. How will the information received in this way be used to protect the species? Why would we want to protect grizzly bears from extinction in the first place? (photo courtesy of John and Frank Craighead)

of baby seals in Canada to provide furs for articles of clothing is often defended as an "economic necessity" for the men who work in this occupation. If so, it may just be true that the price of economic progress is the elimination of some particular forms of lower animal life.

A second kind of threat comes from a most unexpected source: animal lovers. The family that "just has to have" an ocelot, a coatimundi, or a sulphur-breasted toucan may be contributing to the extinction of the very species it has adopted as part of its family. The survival rate among animals who are trapped, transported, and sold in pet stores is terribly low. In many cases, only one out of ten "pets" survives the trip from jungle to human home. The growing popularity of open-air, "natural" wildlife parks is a similar case of the perils in our love for wild animals. Catering to the public's curiosity about exotic forms of wildlife, private owners attempt to transport all forms of animal life from equatorial Africa, South America, and Asia to newly built animal reserves in temperate parts of the United States like New Jersey and Pennsylvania. But sometimes, this practice almost begs for trouble, and health problems among animals in these artificial parks are often enormous. If we want to argue that zoos and wild animal reserves are the only place (and may be the only way) to preserve leopards, panthers, grizzly bears, pandas, and their endangered cousins, our present practices *may* be defensible. But in too many cases, the motivation for these parks is not concern for the species, but desire for profit.

Sports hunting represents yet a third threat to some species. At one time the passenger pigeon was so common in the United States that trees where they roosted were bent down with their weight. But over a period of years, this beautiful bird became extinct at the hand of hunters—sports and commercial—who were less concerned with the survival of the pigeon than they were with their own pleasure or profit. The same story is being repeated today with many species in many places. Hunters continue to seek out trophies of elephant tusks, lion heads, or panther skins although each of these animals destroyed now brings the whole species one step nearer to extinction. Nearly every African nation has laws protecting these animals. But it turns out to be all but impossible to enforce those laws. The only change in human hunting instincts over the past hundred centuries may have been the efficiency with which we work. Cave people used clubs and early Europeans used arrows. But modern sportsmen and women have the advantage of such inventions as low-flying airplanes and helicopters. With these they can pursue their game across plains or over icefields.

Hunters have often defended their forays against wildlife by arguments that some animals are "bad," and the world would probably be better off without them. Thus, many people believe, to one extent or another, that no possible harm could come from the total elimination of mosquitoes, alligators, rattlesnakes, and grizzly bears. That argument may or may not be true. Perhaps the best example of this feeling has been our battle against the wolf. As far back as Greek and Roman times there were campaigns to eliminate wolves. The belief was that they served no earthly purpose and, in fact, were probably "evil." One effect of that campaign has been the almost total elimination of wolves in Europe.

This labeling of wildlife as undesirable has often been tied with yet a fourth reason for the human threat to our animal cousins. The competition for food and space, the expansion of human agriculture is probably the single most important factor in our threat to plants and other animal life. Our destruction of jungles, forests, savannahs, and other natural areas badly upsets the habitat of many other species. To return to the wolf, one species, the red wolf, has almost disappeared from its natural habitat in Texas and Louisiana because ranchers viewed the animals as a threat to their livestock. A program sponsored by the

United States Bureau of Sport Fisheries and Wildlife took care of that problem by paying for the slaughter of 27,646 red wolves over about a decade. The red wolf population in the region was reduced to about 200 to 300 animals. Similar stories can be told for many other predators throughout the United States. As humans expand the areas they want to live in, build in, plant on, or graze animals on, they come into conflict more and more often with other forms of wildlife. As housing developments are constructed on filled-in wetlands in Massachusetts, around the Everglades in Florida, and on mountaintops in California, the natural homelands and food supplies of duck, alligators, bald eagles, and countless other species are disturbed. And the price of human progress is the death or endangerment of yet one more handful of our animal cousins.

Case Study:
Economics vs. Ecology

Which is more important, to encourage the development of one of the only two major urban areas in a state or to protect the extinction of two species of rare fish? That's an issue about which the citizens of Nevada have been arguing for some time.

The unusual geological history of Nevada is responsible for this strange and difficult confrontation between the demands of a modern society and the desire to protect some very ancient animals. Reno and Sparks, two of the few large cities (populations: 82,000 and 34,000 respectively) in Nevada draw their water from the Truckee River. The amount of water that can be taken from the Truckee is relatively modest by most standards. The limitations of this water source, as much as any other factor, place a limit on the growth of Reno and Sparks. City officials in both localities have, in fact, decided to issue no new permits for housing developments until a more reliable water source can be found.

One solution, developers suggest, would be for the federal government to permit the cities to draw water from the Wildhorse Reservoir. Thus far, the government has refused to do that because it uses water from the reservoir to maintain water levels in the Truckee during periods of drought. This allows two rare fish—the cui-ui sucker and the Lahontan cutthroat trout—to survive and breed in the river. If water were diverted from the reservoir, federal officials have pointed out, the survival of these two species would be seriously threatened.

The government's action thus far has been based on the fact that both the cui-ui and the Lahontan trout are relics from the very ancient past. Nevada was once covered by a great ocean that extended over much of the present United States. As the climate changed over millions of years, fish like the cui-ui and Lahontan trout were trapped in a few tiny pockets of water that remained. They evolved along very specialized lines and the communities that survive today are the only ones found anywhere in the world. If they were to be wiped out, the species would be gone forever.

While recognizing the difficult nature of this problem, the city governments in Reno and Sparks see another side to the issue. The economic development of two important urban areas should not be limited, they say, because of two species of fish. The elimination of these species is a small, if unfortunate, price to pay for further urban growth.

The Buck Stops Here

As an unbiased layperson from an adjoining state, you have been asked to help mediate this controversy. Both the federal government and the cities involved have agreed to abide by the decision that you and other members of your committee make. Discuss the issue with other class members who will play roles as you do, and then decide what recommendation you will make to the government and the cities.

Additional Questions

1. The Lahontan cutthroat trout has traditionally been an important food fish for the Pyramid Lake Indians who live in the area. They strongly support the government's current policy on water use. How, if at all, does this additional piece of information influence the decision you made in *The Buck Stops Here*?

2. In what ways and to what extent does sport hunting and fishing represent a threat to the survival of other species today? Try to find specific examples to illustrate your answer.

3. How would your answer to the above question differ (if at all) for commercial hunting and fishing?

4. The argument in the first paragraph of this case claims that the world would probably be no worse off without the presence of certain species. Think of the most offensive, disagreeable kind of animal you can. Would that statement be true for that animal? Explain your answer. Would the statement be true for the mosquito? For the California condor? If you say "yes" for any of the above animals, explain how you decide when to start saying "no" for other species.

5. Throughout the history of the earth, species have come and gone. The whole race of dinosaurs, as an example, came and went without being harassed by humans at all! Why should we be so concerned, then, that the normal process of species extinction is continuing in our own day?

6. To what extent is the problem of endangered species in this country the same as it is in, say, an African country? To what extent, and in what ways, is the problem different?

7. Another form of danger to wildlife not mentioned in the introduction to this problem comes from modern agricultural methods. In what ways would these techniques represent a threat to the survival of wildlife? Consider, especially, the role of pesticides and fertilizers.

8. Some of the most difficult cases of endangered species are found in less industrialized countries. Pandas, African elephants, and orangutans are examples. Humans competing with them are trying to improve their standard of living by extending the land used for agriculture and grazing. This seems like a natural ambition for people in non-industrialized countries. The question here is not how you would feel about this as a native of China, Indonesia, or Tanzania. (That's probably not something we can "imagine" very easily.) Instead, we want to know what you think the role of the United States, if any, ought to be in protecting endangered species like these?

9. Most of this discussion deals with endangered *animals*. In what way would a discussion of endangered *plants* be different? Is this problem as serious as it is with animals? Why or why not?

10. Some zoos have become more than showplaces for animals. They have assumed a major role in protecting endangered species from total extinction. Find out what some of these new functions of zoos are.

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Topic four
Sound public health or forced medication? Fluoridation

Introduction

There is probably no aspect of science that receives enthusiastic support to the extent that public health does. This wasn't always true. Louis Pasteur's pioneer efforts at protecting people from smallpox were met with widespread fear and resistance. Most men and women in the nineteenth century were probably more willing to take their chances with disease than to submit themselves to the doctor's needle.

Today, programs to safeguard the population against disease and epidemic are taken as a matter of course. There is hardly anyone who objects (except for religious reasons) to vaccinations against

Fluoridation is sometimes described as a "public health issue." In what ways is this an appropriate description? In what ways is it inappropriate? (photo courtesy of World Health Organization/T. Farkas)

smallpox, typhoid, diphtheria, and other diseases; to the purification of public water supplies; to the regulation of meat markets, grocery stores, restaurants and other public food outlets; to the construction of adequate sewer systems; and to any number of other practices designed to preserve and protect individual and public health.

The preceding argument ignores, however, one area of public health in which a high level of controversy remains: the fluoridation of public water supplies. Proposals for adding certain chemicals to community water supplies have appeared only quite recently. A number of studies stretching from the late 1920s to the 1940s seemed to suggest that the rate of dental caries (tooth decay) is closely related to the amount of fluoride in drinking water. Specifically, the more fluoride found in the water (up to a point), the less tooth decay there was among people drinking that water. Towns whose natural water supplies were unusually high in fluroide content (for example, Galesburg and Monmouth, Illinois; and Glassboro, Pitman, and Woodstown, New Jersey) were found to have significantly fewer cavities per person than were neighboring communities without fluorides in their water.

Dental researchers were excited about these studies because they held the promise of a method for solving one of the nation's great health problems: tooth decay. They instituted a number of additional studies to see whether decay could be reduced through the artificial addition of fluoride to a town's water supply. The first of these studies was conducted in Grand Rapids, Michigan, beginning in June of 1944. Enough sodium fluoride was added to the city's water filtration plant to raise the fluoride content from a natural level of 0.05 parts per million (ppm) to an experimental level of 1.0 ppm. Over the next ten years, the number of cavities developed by schoolchildren in Grand Rapids was carefully noted and compared with those in children from Muskegon, Michigan (close to Grand Rapids, but with no artificial or natural fluoride in its water) and from Aurora, Illinois (similar in character to Grand Rapids and Muskegon, but with a natural fluoride concentration of 1.2 ppm). The results showed a dramatic decrease in tooth decay among the experimental children. This and similar studies performed throughout the country convinced many doctors, dentists, and lay citizens that fluoridation of public water supplies was an effective means of reducing dental caries. By 1965, virtually every professional organization, both nationally and internationally, and scores of high ranking government officials in the United States and around the world, had endorsed the practice of fluoridation.

The interesting fact, however, is that, in spite of a great many enthusiastic recommendations, a large number of communities still do not have fluoridated water. It's obvious when the question of fluoridating is put to the voters that a great many people—both professionals and laypersons—still have strong reservations about the desirability of adding fluorides to public water supplies. One complaint often heard is that fluorides may actually have a harmful effect on teeth and other parts of the body. One anti-fluoridation pamphlet claims that fluorides increase the rate of such diseases as diabetes, heart disease, stroke, cancer, and mongolism. They are also responsible, it claims, for spontaneous abortions (miscarriages), stillbirths, and crippling disease in children.

Another argument focuses on the fact that fluorides in the water supply represent forced medication of the public, a notion that is repulsive to many citizens. Some public health measures are essential, they say, to prevent the spread of horrible epidemics like typhoid. But tooth decay is hardly a "horrible epidemic." Therefore, people should have the right to *choose* whether they want to use fluorides or not. If placed in the community water supply, they wouldn't have that choice. Thus, after forty years of research and debate, the question of fluoridation of public water supplies is still not settled.

Case Study: Fluoridation

The city commission of Huntsville has received a petition from 250 citizens of the town requesting that fluorides be added to the town water supply. Present studies show that the natural level of fluorides in the water supply is very low, around 0.01 ppm. The average number of cavities per child is slightly above the national average. The petition recommends adding enough sodium fluoride to the water to maintain artifically a level of 1.0 ppm. It claims that this concentration will significantly decrease the rate of dental caries in children and will present no threat to the health of children or adults in the community.

The commission has decided to call for endorsements and objections from local groups and individuals who wish to make their position known on the issue. So far, they have received statements of support for the proposal from the state medical association, the state dental association, the Huntsville Medical Society, the Graham County Dental Association, the Brotherhood of Water Works Employees, and other groups and individuals. Statements objecting to the proposal have been offered by the Physician's Anti-Fluoridation Society, the Dentists

for Good Health Committee, the Huntsville Veterans Association, and other groups and individuals. They have examined the statements from each side in the argument reprinted here:

Statement in favor of fluoridation:

On December 6, 1951, the House of Delegates of the American Medical Association adopted the following resolution with respect to fluoridation of community water supplies: Whereas, carefully controlled studies have demonstrated that fluoridation of water supplies has been definitely beneficial in the reduction of dental caries in the younger age group; and Whereas, the Council on Pharmacy and Chemistry has reported that fluoride is nontoxic in community water supplies up to one part per million; and Whereas, the addition of fluoride to community water supplies seems to have merit; therefore be it Resolved, that the House of Delegates of the American Medical Association endorses the principle of fluoridation of community water supplies.

Statement against fluoridation:

All that has been said in explanation (of fluoridation of public water supplies) is that when small amounts of fluoride are added to drinking water (larger amounts are fatal) they enhance the resistance of small children to tooth decay.
Small children constitute perhaps one quarter of the population.
Older children and adults, who make up the remaining three-fourths of the populace, receive no benefit whatever from fluoridated water.
Fluorides are available in the form of pills which could be dissolved in the drinking water of children whose parents so desired.
There is, therefore, no need to force all the people to drink chemicals in order to protect the teeth of susceptible young children.
(From "The Real Danger in Fluoridated Water," by John Lear, *Saturday Review*, December 7, 1963, p. 77.)

The Buck Stops Here

As a public-spirited citizen of Huntsville, you are naturally concerned that the commission make the decision that is best for the community. After reading the above statements and any other references you can find on the subject, decide whether you would favor or oppose the proposal which has been offered. Prepare a brief statement explaining why you feel as you do.

Additional Questions

1. Find out if the water in your community is now fluoridated. If so, also find out who made the decision and what public debate, if any, accompanied that decision. If not, see if there are any plans to introduce fluorides. What groups and/or individuals have taken a stand on this issue?

2. See what scientific information you can collect on fluorides. What kind of compounds are they? What evidence is there that they are helpful or harmful to the human body?

3. Select one local doctor and one local dentist to interview on the subject of fluoridation. What points do *they* think are most important in this controversy? Discuss the results of your interview with other members of the class.

4. Some people have been puzzled by the fact that referenda on the fluoridation issue lose much more often than they win, in spite of the fact that fluoridation has been supported by almost every major scientific, governmental, and "public interest" group in the country. Can you explain why this might be so? The following articles deal with this subject. You may want to read one or two of them and discuss the points they make with other class members.

Background Reading List

Burns, J.M. "Crazy Politics of Fluoridation." *The New Republic*, July 13, 1953, pp. 14–15. *One New England town was "saved" from the "Communists," "saboteurs," and the plots of the "World Planners."*

"Court vs. Fluoridation in Pittsburgh Suburbs." *Science News*, November 25, 1978, p. 358. *Anti-fluoridationists win again.*

"Fluoridation: The Cancer Scare." and "Six Ways to Mislead the Public." A two-part series in *Consumer Reports*, July and August, 1978, pp. 392-396 and 480–482. *An assessment of claims made by anti-fluoridationists.*

"Fluoride Proposal Draws Criticism." *Science News*, November 23, 1985, p. 330. *Efforts to increase the maximum permitted level of fluoride concentration in drinking water prompts the latest round in the fluoride wars.*

Gamson, W.A., and P.H. Irons. "Community Characteristics and Fluoridation Outcome." *Journal of Social Issues*, Winter 1966, pp. 66–74. *An examination of the characteristics of those who favored and*

opposed a vote on the fluoridation of the city water supply.

Groth, Edward III. "Science and the Fluoridation Controversy." *Chemistry*, May 1976, pp. 5-9. *An overview of the public controversy over fluoridation.*

Mandel, Irwin D. "Dental Caries." *American Scientist*, November-December 1979, pp. 680-688. *A general review of this health problem with brief commentary on the effects of fluoridation.*

Mausner, Bernard and Judith. "A Study of the Anti-Scientific Attitude." *Scientific American*, February 1955, pp. 35-39, with discussion in April 1955, p. 2. *Both this article and that of Sapolsky (below) deal with the question of why voters so consistently reject a public health measure which has received such widespread approval among professional scientists.*

"Red Scheme for Mass Control." *The American Mercury*, November 1959, pp. 134-135. *Fluoridation is seen as a mechanism for reducing "the resistance of the masses to domination and control and loss of liberty."*

Sapolsky, Harvey M. "Science, Voters, and the Fluoridation Controversy." *Science*, October 25, 1968, pp. 427-433, with discussion in January 3, 1969, p. 17. (See Mausners, above.)

Shaw, J.H. "Should Fluorides be Added to Public Water Supplies?" *Scientific Monthly*, October 1954, pp. 232-240.

"What Are We Waiting For?" *American Journal of Public Health*. February 1951, pp. 224-226, with response in May 1951, p. 586. *With all the scientific evidence favoring the fluoridation of public water supplies, why is there a delay in taking this step in all communities?*

During the 1960s, *The Saturday Review* carried a long series of articles and letters on the topic of fluoridation. Among these are: John Lear, "The Real Danger of Fluoridated Water." December 7, 1963; "Documenting the Case Against Fluoridation." January 4, 1964, pp. 85- 92; "Fluoride and Civil Liberty." January 2, 1965, p. 91; "New Facts on Fluoridation." March 1, 1969, pp. 51-65; "Fluoridation and the Dentist." August 2, 1969, p. 50; Norman Cousins, "Fluoridation." February 15, 1964, p. 24; Frederick J. Stare, *et al*, "Fluoridation and 'New Facts.'" May 3, 1969, p. 57 *(rebuttal to Lear's article of March 1)*; letters in February 1, 1964, pp. 49-52; March 7, 1964, pp. 51- 53; May 2, 1964, pp. 47-49; August 1, 1964, p. 44; April 3, 1965, pp.55-56; October 2, 1965, p. 73; April 15, 1969, p. 72; June 7, 1969, pp. 57-58; July 5, 1969, pp. 47-49; September 6, 1969, pp. 59-60.

Topic five
Too many people, ! or ?
Population issues

Introduction

The world has a serious population problem. True or false? At first glance, the answer to that question may seem obvious. Certainly thousands of people around the world are dying from starvation every day. Millions more go to bed hungry every night of their lives. The population of South America, to take just one example, quintupled from about 60 million in 1900 to almost 300 million in 1970. It will double again before the year 2000. The fruits of this uncontrolled growth are hunger and disease, social and political unrest, inadequate housing and education, growing slums and declining employment . . . a virtually endless list of societal ills. The situation in India is at least as bad and probably better known to the world. Interestingly enough, India's present miseries no longer spring from a rising birth rate, but from a sharply declining death rate, especially a rapidly falling rate of infant mortality. Thus, a nation's efforts to promote "planned parenthood" and to improve public health practices have resulted, in fact, only in more serious population problems than the nation has ever faced!

Even our own nation, with millions of acres of "wide open spaces," is considered by some to be facing a population crisis. In his message to Congress of July 18, 1969, President Nixon said:

In 1917 the total number of Americans passed 100 million, after three full centuries of steady growth. In 1967—just half a century later—the 200 million mark was passed. If the present rate of growth continues, the third hundred million persons will be added in roughly a thirty-year period. This means that by the year 2000 or shortly thereafter, there will be more than 300 million Americans.

This growth will produce serious challenges for our society. I believe that many of our present social problems may be related to the fact that we have had only fifty years in which to accommodate the second hundred million Americans. In fact, since 1945 alone some 90 million babies have been born in this country. We have thus had to accomplish in a very few decades an adjustment to population growth which was once spread over centuries. And it now appears that we will have to provide for a third hundred million Americans in a period of just 30 years.[1]

In view of the population situation here and abroad, there is mounting interest in population control throughout the world. These efforts are focused on a rather simple equation:

The population of a country =

number of births +

number of immigrants –

number of deaths –

number of emigrants

In many cases (in the United States, for example), immigration (people coming into the country) and emigration (people leaving the country) make almost no significant changes in the total population. Thus, the

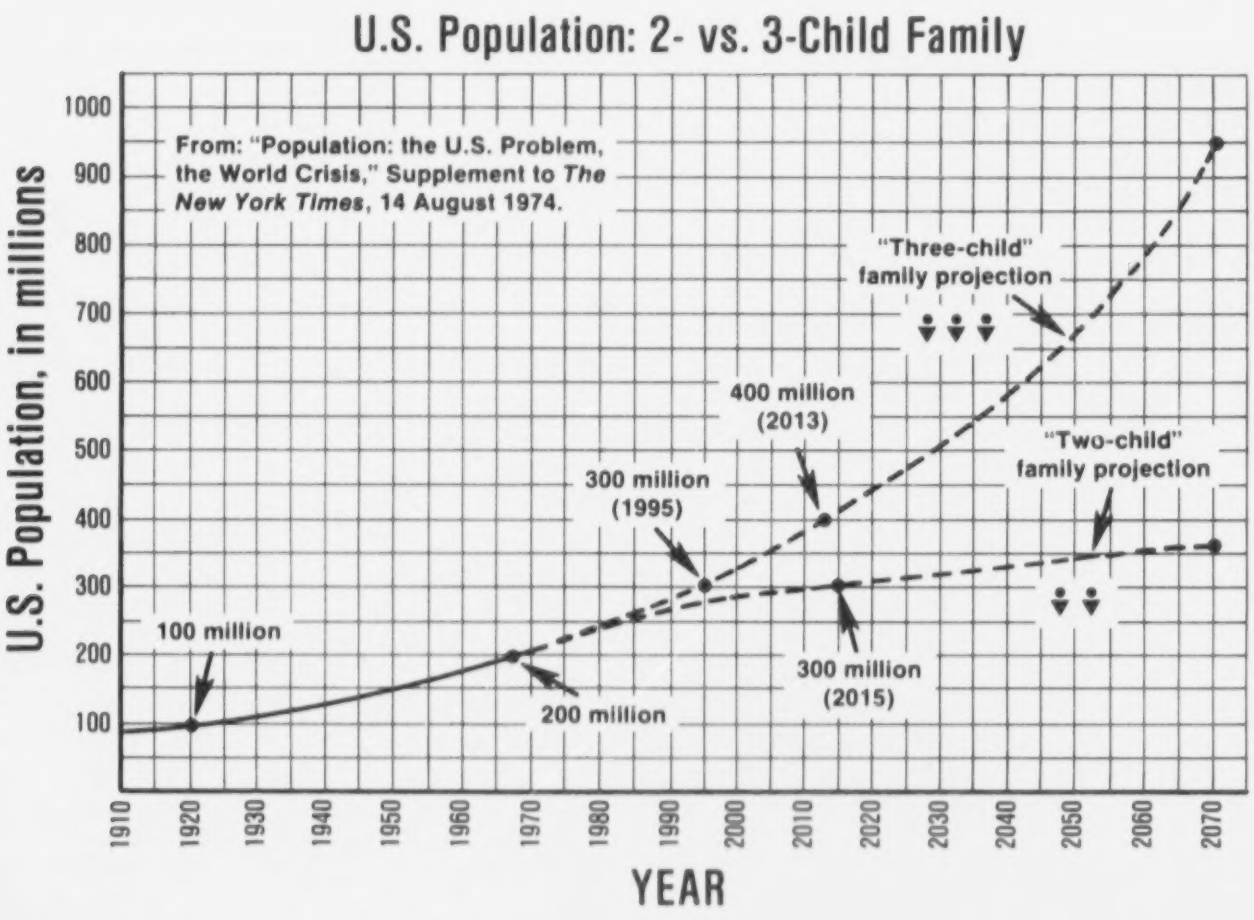
[1] *New York Times*, August 14, 1974.

Is the United States overpopulated? How does your answer to this question fit with this photograph of the wide-open spaces, a common scene in many parts of the West? (photo courtesy of U.S. Department of the Interior, Bureau of Land Management)

only really effective way to limit a nation's size is to increase the death rate or decrease the birth rate. Since the first alternative is almost universally rejected on moral grounds, population control, in fact, generally means birth control.

What is a desirable birth rate for a nation? It's obvious that simply in order to maintain population at a constant size, each family should produce two children. In fact, because of the infant mortality rate, constant population in this country is maintained at 2.08 children per family. When each family produces an average of more than two children, each succeeding generation will be somewhat larger than the previous one. The graph in Figure 1 illustrates the difference in population growth for two- and three-children families. One interesting point to note in this graph is the time it takes for population policy to take effect. Thus, in this example, if the international average of two children per family were achieved by the year 2000, population would continue to increase for almost seventy years. Then it would begin to level off.

This "time lag" alone is reason enough for many observers to push actively for programs of birth control *now*. In most cases, the argument is for some form of *voluntary* birth control. In this country, we have a long tradition of cherishing individual rights (at least in theory). The hope is that we can solve our population problems by convincing people of the importance of limiting births. Thus, *educational programs* are an essential part of birth control efforts in this and many other countries. But what are the specific *techniques* for limiting births? There are, first of all, a number of contraceptive methods: the "pill," vasectomy for



men, sterilization of women, contraceptive devices like the IUD (intrauterine device). All of these mechanical devices are intended to prevent conception from occurring as a result of intercourse.

In addition, there is the possibility of terminating pregnancy before the birth of the child: abortion. Although fiercely opposed by some groups in this country, abortion has been an effective birth control mechanism in other countries. Finally, a number of economic and social pressures can be used, in conjuction with these specific techniques, to reduce birth rates. It would be possible, for example, to increase the tax rate for larger families rather than, as we do now, reward big families with tax breaks. If parents suffered financially (in terms of taxes) for having more children, they might be less inclined to want big families.

A difficult problem is, however, that *voluntary* birth control may, in some places and at some times, be inadequate to reduce birth rates. It's conceivable that no matter how hard we tried to convince people to have fewer children, they would ignore this advice and continue to produce large families. Garrett Hardin has presented the interesting argument, in fact, that this state of affairs is exactly what we *should* expect to observe in the case of population patterns. (See "The Tragedy of the Common," *Science*, CLXII [December 13, 1968], pages 1243-1248.) What, then, should or must be done to reduce population growth to an acceptable level?

One possible answer, of course, is to institute *compulsory* birth control measures. The number of children allowed to a family, for example, might be regulated by law. Women might have to have licenses to bear children. It might also be possible, as another example, to add birth control pills to the public water supply. This would forcefully limit population growth in some particular area. While most people would probably regard these as repulsive alternatives, some responsible scientists and laypersons have reluctantly recommended them as our only hope for solving the world and the nation's population problems. Whether population growth should be controlled by voluntary or compulsory methods (or whether it should be controlled *at all*), what mechanisms of birth control can best be used, and exactly *what* the nature of our "population problem" is are questions for which there are no widely accepted answers as yet.

Case Study #1:
Population issues and foreign policy

By almost any definition, "Bandura" has a population problem. Intensive educational campaigns have failed to convince the citizens of this tiny equatorial nation that small families are desirable. The birth rate is still high, the average family size is 3.4 children per family, and the population will probably double within the next eight years. Meanwhile, the people of Bandura are destitute. Barely 15 percent of the population can read, only 60 percent of eligible workers are actually employed, and the average annual income is $58 per year. Bandura exports 83.6 percent of all its crops (primarily copra) to the United States.

Because of its strategic geographical position, Bandura is an

A great deal of land in Indonesia is taken up with rubber plantations, such as the one shown here. Is this making the best possible use of the land in Indonesia? Explain your answer. Who should decide how this land ought to be put to use? (photo courtesy of Goodyear Tire Company)

important link in the United States government's new SPAROD distant warning system. We supply Bandura with (1) enough foreign aid to finance 71 percent of its total budget, (2) an extensive arsenal of conventional weaponry, and (3) an unusually good program in public health and medical assistance for the Bandurans. The latter item, as a matter of fact, accounts for the dramatic drop in death rates in Bandura, a second factor contributing to the nation's population explosion.

The nation's population problem has now become a major concern for American politicians. Feeding and caring for the booming population of Bandura is an increasingly expensive matter. Further, unemployed, uneducated, hungry mobs have begun to threaten the political stability of King Farvozi's government. The question now facing the United States government is whether we should "stick our noses" into the Bandurans' population crisis.

The Buck Stops Here

How would you answer each of the following questions, assuming you were (choose one): (1) Director of the Planned Parenthood Commission in Bandura, (2) Minister of Defense, Government of Bandura, (3) Chief Liaison Officer in Bandura, United States Department of Defense, (4) American Ambassador to Bandura, (5) An unemployed worker in Bandura, (6) A citizen of the United States.

1. Is population growth currently a "problem" in Bandura? Why or why not?

2. Does the United States government have the right or responsibility to become involved in the domestic affairs (i.e., solving the "population problem") of Bandura? Why or why not?

3. What action should the Banduran government take to work out its own solution to the "population problem"?

Additional Questions

1. In what ways could the United States government influence Banduran policy on population issues? Which ways would be tried and which not tried?

2. What arguments would a family in an underdeveloped nation offer for having large families? What arguments would the nation itself offer for encouraging large families?

3. In what ways would the population problems of the United States differ from those of Western Europe? of Japan? of South America? of Africa?

4. Probably the best known, most effective national system of birth control we know of exists in Singapore. Find out as much as you can about this program. In what ways are small families encouraged? How was the program introduced in Singapore? How effective has it been? Should a similar program be introduced in India? In the United States? In selected parts of the United States? Why or why not, in each case?

5. In what ways does Bandura's one-crop economy benefit poor people in Bandura? What groups of people are most likely to benefit from Bandura's present economic system? What problems would there be in trying to convert from this system to another based on crops which would have domestic value for Bandurans?

6. What real countries do you know of that have "one-crop" economies? What kind of population problems do these countries have? Is there a connection between the two parts of this question?

7. In what way do United States citizens benefit from one-crop economies in other nations? In what ways are they harmful to us? Should the United States have a "policy" about population in one-crop economies?

8. In what way does the political structure of a government influence its attitude toward population problems? That is, would a capitalist society (the United States, for example), a communist nation (Cuba), a socialist state (Sweden), and a dictatorship (Argentina) *define* and *try to solve* population problems differently? If so, how? If not, why not?

Case Study #2: Population control in the United States

Is overpopulation a problem in the United States? The answer to that question depends on whom you ask, when you ask the question, and other factors. Garrett Hardin is one biologist who thinks the answer is "yes." He has written a number of important articles dealing with population issues. The following editorial presents a radical and controversial suggestion for limiting population growth. The necessity for such a drastic proposal stems from Hardin's own beliefs that efforts to convince people by argument and reason to

limit family size are naive and unworkable. He concludes that we have no real choice *but* to impose certain restrictions such as those he suggests.

*Parenthood: right or privilege?**

Garrett Hardin

Birth control is not population control. Individual goals, not community needs, motivate individual actions. In every nation women want more children than the community needs.

How can we reduce reproduction? Persuasion must be tried first. Tomorrow's mothers must be educated to seek careers other than multiple motherhood. Community nurseries are needed to free women for careers outside the home. Mild coercion may soon be accepted—for example, tax rewards for reproductive nonproliferation.

But in the long run a purely voluntary system selects for its own failure: noncooperators outbreed cooperators. So what restraints shall we employ? A policeman under every bed? Jail sentences? Compulsory abortion? Infanticide? . . . Memories of Nazi Germany rise and obscure our vision.

We need not titillate our minds with such horrors, for we already have at hand an acceptable technology: sterilization. The taboo on this subject is fast dissolving, thanks to Arthur Godfrey and Paul Ehrlich, who have confessed their sterilizations in public. Fear (mostly unjustified) about the safety of the "pill" has motivated multitudes to follow in their footsteps.

It should be easy to limit a woman's reproduction by sterilizing her at the birth of her *n*th child. Is this a shocking idea? If so, try this "thoughtful experiment": let $n = 20$. Since this is not shocking, let n diminish until population control is achievable. The Women's Liberation Movement may not like it, but control must be exerted through females. Divorce and remarriage play havoc with assigning responsibility to couples or to men. Biology makes women responsible.

Many who want no third child would fight resolutely for the freedom to have that which they do not want. But what is freedom? Hegel said that "Freedom is the recognition of necessity." People need to recognize that population control is needed to protect the quality of life of our children.

The "right" to breed implies *ownership* of children. This concept is no longer tenable. Society pays an ever larger share of the cost of raising and educating children. The idea of ownership is surely affected by the thrust of the saying that "He who pays the piper calls the tune." On a biological level the idea of ownership of children has not been defensible for almost a century, not since August Weismann drew his celebrated diagram of the relationship of germ plasm to somatoplasm.

Biologically, all that I give "my" child is a set of chromosomes. Are they *my* chromosomes? Hardly. Sequestered in the germinal area long before *my*

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*From *Science 1969* (July 1970): p. 427 and October 16, 1970, pp. 257-262. Copyright 1970 by the American Association for the Advancement of Science.

birth, "my" gonadal chromosomes have lived a life of their own, beyond my control. Mutation has altered them. In reproduction, "my" germ plasm is assembled in a new combination and mixed with another assortment with a similar history. "My" child's germ plasm is not *mine*; it is really only part of the community's store. I was merely the temporary custodian of part of it.

If parenthood is a right, population control is impossible. If parenthood is only a privilege, and if parents see themselves as trustees of the germ plasm and guardians of the rights of future generations, then there is hope for mankind.

Choices of parenthood

While I agree wholeheartedly with the general theme of Hardin's editorial (31 July, p. 427) that parenthood should be considered more as a privilege than a right, I disagree with his statements that "in every nation women want more children than the community needs" and "control must be exercised through females." As far as we know, in most nations with overpopulation as a recognized problem, men are no less desirous than women of having children. Women are rather more inclined toward the restriction of the number of children because of the sufferings and inconveniences caused by child-bearing. The method of control advocated by Hardin, namely sterilization, is more suitable for men than for women from medical and economic points of view. There is no reason to suppose that population control has to be exerted through women only.

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In "Parenthood: right or privilege?" Hardin says: "It should be easy to limit a woman's reproduction by sterilizing her at the birth of her *n*th child. Is this a shocking idea? If so, try this 'thought-experiment': let $n = 20$. Since this is not shocking, let n diminish until population control is achievable. The Women's Liberation Movement may not like it, but control must be exerted through females: Divorce and remarriage play havoc with assigning responsibility to couples or to men. Biology makes women responsible."

. . . Perhaps Hardin should review his biology, for men are just as responsible for producing children as women! I cannot find a biology textbook which states that men have a right to father more children than women may mother. In spite of divorce and remarriage, it would be just as effective in limiting population to sterilize all men as to sterilize all women. Since men are easier to sterilize, it would make more sense to sterilize men than women if you are going to sterilize anybody.

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. . . Compulsory sterilization is shocking at any n. I am certain large numbers of Americans would sooner reproduce unofficially than submit to it. The

apparatus of police, informers, and punishment which would follow could be as nightmarish as a standing-room-only world.

Before such Draconian measures merit consideration, the following conditions should exist: (i) Abortion should be available on demand, and with no wait, in every state. (ii) Severe tax liabilities should be imposed on both couples and individuals with children. (iii) A federal campaign for population stability should be undertaken in the media. This campaign should be at least as visible as the war bond or highway safety programs, and should express a continuing government commitment to limit population. (iv) The welfare class must be reconciled to the universal imposition of financial penalties for excessive reproduction. Fear that welfare patrons, particularly black, will opt out of a national population policy is reasonable, since a society whose racial proportions are changing is inherently unstable. The situation is far from hopeless, however, and many incentives, as opposed to coercive policies, remain to be tried. For example, welfare benefits for excess children could be paid entirely in kind, rather than in cash. Women on relief, and their female children, could receive a cash bonus for every year in which they do not reproduce. Considering the actual costs of medical care, schooling, and crime control associated with children on welfare, this bonus could be as high as $1,000 per year for each female between the ages of 12 and 45, and still be of no net cost to the agencies paying it.

The fact that people want large families is of little relevance if they have to pay for them on a cash-and-carry basis. After all, most people also want expensive cars, but defer buying them from month to month for reasons of economy. . . .

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The blatant but possibly unconscious male supremacism expressed by Hardin brings out an important consideration about institution of limitations to the right of parenthood. I can see no justification for a reproduction limitation applicable to the female alone, since a number of equitable plans can be devised with respect to male parental responsibility. For example, I suggest that male parental responsibility might be established, at any time from before conception to shortly after birth, by mutual consent of a male and the female bearing the child. Both persons would then have equal responsibility and rights with respect to the child, and both would approach by one their individual reproductive limits, attainment of which would result in mandatory sterilization. If the mother failed to establish paternal responsibility, she would lose her right to the child (to be taken over by a governmental agency for adoption or rearing) and would have her reproductive allowance reduced by one. Such a plan would promote responsibility in parenthood on the part of both sexes.

Although any form of mandatory reproductive limitation would meet with considerable resistance, discriminatory application of such limitation to any selected segment of mankind (as proposed by Hardin) would guarantee and, in my opinion, justify tremendous additional opposition.

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. . . Modern medicine seems to convey the following message: Surgical sterilization in the female terminates reproduction nearly entirely since restoration of the tube passage does not restore the tube's vital function for early embryonic life. In the male, surgical sterilization can be revoked by recanalization with only slight chances of regaining full fertility, but this is not necessary. Ample numbers of sperm can be obtained by puncturing the epididymides, suitable for artificial insemination. Does it still make sense to hold women solely responsible? If the privilege has to be granted, or if the right for a child can be claimed, does it not make sense to take advantage of the semen depot readily available in sterilized men, samples of which can even be checked for their biological value by numbers, morphology, and biochemistry? Artificial insemination is highly successful, as long as the mother's genital tract can function unimpaired. How successful the procedure will be to gain eggs by laparotomy, to fertilize them in vitro, and transfer them to the mother's uterus in time, nobody knows. And even if successful, cost and procedures involved are highly in favor of artificial insemination to an unimpaired female.

If it is true that mankind is entering the age of equal rights and responsibility for both sexes, it is inconceivable to put burdens on one sex or the other as long as alternatives exist. The widely discussed and proposed punitive actions any elected government or society can impose on those breaking newly established laws or moral codes should leave the choice of the method open to responsible parents, but should give them all possible advice and tell them of the other side of any method involved. Any method with the assurance of reasonable safety and true reversibility should have priority.

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. . . Hardin could benefit the world much more if he would concern himself with the quality of parenthood. Problems of crime, moral dissent, and lack of convictions to help society could be corrected, in my mind, through better home life and by better-qualified parents. Divorce and unhappy homes to me are critical problems in terms of human suffering and welfare. Should not the criteria of training people to be better parents and to care properly for their children be more important than whether they have one, two, or three children? In fact, in my association it has often been the parents of larger families that seem to concentrate more heavily on caring for the children and instilling in them a sense of responsibility to society . . . parenthood is not a question of right or privilege, but a problem of responsibility.

Darrell J. Weber

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We will not achieve population control overnight. Progress will be made in stages, and I agree with Berkhout that abortion should first be made freely and instantly available to any woman who wants it. Contraception, never perfect, always leaves open the possibility of an "accident"; freely available abortion eliminates both the tragedy and the excuse. Since 1963, I have been heavily engaged in writing and speaking in favor of elective abortion.

Cash rewards for nonreproduction are also a fine idea. I believe R.B. Cowles was the first to propose a non-baby bonus, in 1959. It would not be necessary to continue it until the climacteric, as Webb implies: probably to age 25 would be far enough. Young women are dangerously fertile for both physiological and psychological reasons; they often seek to solve their psychiatric problems by conceiving. By the time they are 25 they have a better understanding of the costs of motherhood, and are less tempted by this "solution."

Tax penalties for excessive reproduction may help, but they have several shortcomings. (i) They cannot have much effect on people who pay no taxes anyway. McClenon rather surprisingly assumes that parents of large families are necessarily taxpayers. (ii) Insofar as taxes hurt the parents this hurt may be passed on to the children, whom the community does not want to harm. (iii) Highly "philoprogenitive" parents will be less affected by such measures, and will produce more of their own kind, thus instituting an unwanted selective system, as Charles Galton Darwin pointed out in 1959.

Positive control is distasteful to everyone, including me. But I think we will someday have to accept it as the price for other changes already made. Two centuries ago there was no need for the state to interfere with family breeding because the community allowed surplus children to starve. [See, for instance, Linnaeus' account of the acceptance of such starvation in K. Hagberg's *Carl Linnaeus* (Dutton, New York, 1953), p. 118.] The family was responsible for making the correct breeding decision. Now, welfare economics has freed the family of much of the responsibility, while leaving it the full power of breeding. Power without responsibility produces an unstable system, always.

Twenty years ago I was sterilized after my wife and I had produced what we regarded as our *n*th child. I watched the doctor perform the vasectomy; I found nothing horrifying in the operation. I have since recommended sterilization to thousands of people. Rational couples usually settle for male sterilization as the cheaper and simpler of the two possibilities. I think this is usually the best *individual* decision.

Population control would probably be least irksome if it involved two steps: (i) a directive to have no more than *n* children, control to be achieved by whatever means individual couples preferred; coupled with (ii) positive community action after $n + 1$ children have been born to prevent the appearance of $n + 2$ *et al*. Our experience with Prohibition has taught us that positive control is not feasible unless the *vast* majority is convinced of its necessity; when that stage is reached the recalcitrant minority that would have to be sterilized would be small.

If community control ever comes—and it may not—it will be far easier to build the controlling mechanisms around the female than the male. The reasons for this conclusion escaped many of my critics, so let me spell them out.

Whether control is exerted by sterilization or by punitive taxation is of secondary importance. The point is, we want to make it difficult or impossible for a person or a couple to produce more than their share of children. Suppose we decide that it is the couple's joint responsibility, that each child counts against their quota. How should we deal with the following cases?

1. Mary and John get divorced, after having two children. Mary takes the children. Both remarry, their new partners having had no children previously. Suppose Mary's new husband wants a child "of his own"—can he have one? If so, Mary must exceed *her* quota. What if John's new wife wants to be a mother—is she forbidden to do so because John has twice fathered children? If she promised to conceive extramaritally, would that make it all right?
2. A young woman has intercourse with several men in one month and becomes pregnant. She doesn't know who the father is, and "paternity tests," which can only exclude some of the candidates, do not tell us. Should each of the nonexcluded men be charged with one child? Or only a fraction of a child?
3. Five men and three women join a group marriage. If a quota is to be assigned to the group, what is it?
   $3 \times 2 = 6$? $5 \times 2 = 10$? $[(5 + 3) \div 2] \times 2 = 8$?

We haven't even considered the complications introduced by extramarital affairs, and the legal consequences of condonation. I'm afraid there are more patterns of marriage and sex than are dreamt of in Doris Day's philosophy. The law ignores this variety at its peril.

The chain of legal evidence that establishes maternity is really quite good. The evidence for paternity is always shaky, and putting a policeman under every bed really wouldn't help. "It's a wise father that knows his own child," said Shakespeare, and the science of immunology hasn't helped much.

To achieve community control of breeding, would it "be just as effective," as Webb says, "to sterilize men as to sterilize all women"? *By definition*, yes; but there has been no proposal to sterilize *all* of either sex. If only some are sterilized, and those only after they have had children, the effectiveness of the two alternatives is not the same.

Debaters tend to forget that we are not a perfectly monogamous people. Extramarital intercourse is not rare; and divorce and remarriage create what has been called "serial polygamy." For these reasons the sterilization of x men can be expected to be less effective in reducing births than the sterilization of x women.

My statement that women "want more children than the community needs" was based on the evidence assembled by Kingsley Davis [*Science* 158, 730 (1967)]. But it must be admitted that "wants" are not permanent facts of life like chemical valence and specific chromosome numbers. We may not be able to modify wants; we should seek to do so.

I do not think my identifying women as the intrinsically responsible sex in reproduction is the result of "blatant but possibly unconscious male supremacism," as Butler put it. Once women have at their command a perfect system of birth control (contraception plus elective abortion as a backstop), they will have almost complete power over the reproductive process. A woman who wants a child can easily find a man to furnish spermatozoa.

When women can completely avoid having children they do not want, men become powerless to "have children" by a unilateral decision. The sexes are not equal.

Power and responsibility need to go together; there really is no defensible reason why women should reject responsibility once they possess—and realize they possess—power.

Garrett Hardin

Department of Biological Sciences,
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The Buck Stops Here

Write a letter to *Science* magazine expressing your own views on Hardin's editorial, the letters responding to that editorial, and Hardin's final rejoinder. Be prepared to debate the position you take with other members of the class.

Additional Questions

1. The Hardin editorial and letters were written in 1970. How, if at all, have population issues in the United States changed since that time? Is there any way to predict changes that will take place concerning this issue in the next ten years?

2. Hardin's argument is that (1) voluntary methods of population control do not work and, therefore, (2) governmental regulations have to be developed to control population. Tell why you agree or disagree with each of these two arguments. If you agree with (1) but disagree with (2), what alternatives can you suggest for limiting population?

3. Hardin raises some *scientific* issues in his editorial. Identify at least two of these. Then decide whether Hardin's statements on these are "strictly factual" ones, to which all good scientists are likely to agree.

4. Is overpopulation a problem in the United States right now? Explain how you answered this question as you did.

5. Find out as much as you can about each of the following population control mechanisms. This might include learning (1) how the mechanism works, (2) special advantages it offers, (3) handicaps or dangers associated with its use, (4) other disadvantages in using the mechanism, (5) desirability and effectiveness as a population control mechanism, and (6) extent of current use and probability of future use:

   a. abortion

   b. intrauterine device (IUD)

   c. the "pill"

   d. male vasectomy

   e. female sterilization

6. Write a statement which explains which of the above methods you would favor as a birth control device or system OR write a statement explaining why you would favor NO method of birth control at all.

Case Study #3: Population problems in the United States: A minority report

Not all people view population issues in the same light. Another angle from which one might examine the question of population is that of a minority group. To a black, a Mexican-American, a Puerto Rican, or another member of a racial minority, the idea of limiting birth rates may have quite another meaning than it does to a white American. From the simplest standpoint, racial minorities (as well as poor whites) tend to have a somewhat higher birth rate than do white middle- and upper-class families. In this respect, birth control programs could be viewed as discriminatory. Some militant black leaders have even called zero population growth programs a campaign of genocide against America's minorities.

From a practical standpoint, limiting population growth is not a "smart" move for minority groups.

The success which blacks and a few other minorities are just now beginning to experience in politics is a reflection of their numbers. A crucial (if not exclusive) reason that Jersey City, Gary, and Cleveland have elected black mayors is that each of these cities has a large black population. Today, there are over fifty metropolitan areas where blacks constitute over half the population. Given recent progress in one-person, one-vote legislation and judicial decisions, the time may not be far off when blacks will control a significant number of local governments. The same argument can be made for Mexican-Americans in Texas, California, and other parts of the southwestern United States.

Supporting population control, which would certainly limit their numbers, might then be a very unwise decision for minority groups. Their efforts might better be devoted to obtaining a more just redistribution of the national wealth. After all, with about 11 percent of the nation's population, blacks hold only 2 percent of the nation's wealth, receive less than 1 percent of the nation's business income, and control only 0.02 percent of the country's banking assets! Under these circumstances, holding down the number of births per family may be a relatively trivial matter of concern for minority groups.

Basing their position on the above argument, the Black and Hispanic Caucus of the United States House of Representatives has introduced HR 242. This bill would prohibit the use of any federal funds for the use of population control programs. Included among these would be birth control information and techniques, funding for abortions, support of sex education programs, research on contraceptive devices, family planning clinics, and the like.

The Buck Stops Here

Assume any one of the roles listed below. Then decide how you would lobby your congressperson on HR 242.

1. A black citizen of Newark, NJ
2. A white citizen of Newark, NJ
3. A Cuban refugee citizen in Miami, FL
4. A native-born white Miamian
5. A native American citizen in Spokane, WA
6. A white citizen of Spokane,WA

Additional Questions

1. Decide whether you would agree or disagree with the proposition that population control is a discriminatory policy. Then, prepare a statement that would argue *against* the position you believe in.
2. Suppose the majority of Americans feel that population control is necessary in this country, but spokespersons for minority groups strongly disagree. What policy should the government adopt with regard to population issues in a case like that?
3. Is it true that *all* minorities tend to have a higher birthrate than white middle-class Americans? For those for whom this *is* true, what are the reasons for this phenomenon?

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Topic six
Bugs in the bug-killers: Pesticide problems

Introduction

How would you like to be in charge of a battle against an enemy with over a million *armies* on its side and an unlimited number of soldiers to do battle . . . in a war that has been going on a million years? That doesn't sound like the kind of fight that would appeal to many people. But it's probably a fair description of the human war against the insects.

One exaggeration in our analogy may be in the number of armies with which we have to do battle. It's true that there may be as many as ten million species of insects in the world. But less than a thousand are actually enemies of humans. Even this "small" number is not to be regarded lightly, however, for the human death and disaster insects can cause is enormous. They compete with us, in the first place, for food and other agricultural products. The corn borer likes corn as much as we do. Fruit flies compete with us for a wide range of commercial fruits. The Japanese beetle has a voracious appetite for the same fruits and vegetables headed for our tables. Leafworms and boll weevils often harvest cotton plants faster than human workers can get to them. And so the story goes. There are literally hundreds of examples in which crops grown for human use and consumption are under relentless attack by insect enemies. One recent estimate placed the annual loss in food crops due to insect pests at approximately three billion dollars. The loss in a single crop (corn) due to a single pest (the corn borer) has gone as high as 120 million bushels in a single year (1963)!

In addition, insects are the mechanisms through which many serious diseases are transmitted. The mosquito is well known as the agent through which a whole host of diseases—yellow fever, malaria, encephalitis, and filariasis, for example—are spread. Bubonic plague, typhus, and tularemia are only a few more of the diseases harbored in the bodies of beetles, fleas, ticks, and other bugs. Humans are not the only victims, of course. Texas cattle fever, dog tapeworm, and many other afflictions of lower animals are also passed on by insects. Even plant diseases like Dutch elm disease and cucumber wilt are now known to be transmitted by means of fungi and bacteria carried by insects. It doesn't take long lists of statistics to remind you of the devastation from disease these insects have caused. Malaria alone has always been one of the most dreaded diseases with millions of fatalities worldwide each year. According to the best estimates available, as many as 250 million cases of that one disease may have existed as recently as 1955. The same story can be repeated many times over for human, animal, and plant diseases transmitted by insects.

Obviously, a means for controlling insects would have an enormous effect on the world's economy and health. The principle is really quite simple: The easiest way to get rid of an insect—or any other living thing—is just to poison it. Find a substance that will kill corn borers (for instance), sprinkle it on the growing corn plant, and, presto, no more corn borers. Compounds which kill insects, fungi, and weeds are called, respectively, insecticides, fungicides, and herbicides.

Efforts to produce pesticides are relatively old. Paris green, a poisonous arsenic compound, was first tried as an insecticide before 1875. A copper-based compound, Bordeaux mixture, was being used in fruit sprays in the 1880s. And some insecticides based on natural products (such as nicotine and rotenone) have been used for nearly a hundred years. While natural and

organic compounds like these have a long history, the most effective insecticides are those organic compounds produced by research only quite recently. The most famous of these is p-dichlorodiphenyltrichloroethane (DDT). The compound was known in the late 1800s, but it was not until World War II that DDT found widespread use as an insecticide. Put to work at first as an agent against typhus, DDT was soon found to be effective against an impressive array of pests, such as army worms, blister beetles, caterpillars, corn borers, and more than 100 other kinds of insects that feed on crops and livestock. Primarily as a result of the use of DDT, the incidence of murine typhus (to mention only a single example) dropped from almost 6,000 cases in 1944 to less than 1,000 cases only six years later.

Transported to agricultural fields, DDT was equally impressive in increasing crop yields. It was almost totally effective at first against insects that attack corn, wheat, rice, and other essential crops. DDT soon became as crucial to the farmer as was fertilizer or the plow. By the middle of the 1960s, the production of DDT had risen to seventy million kilograms (154 million pounds) a year. There was hardly a place in the world that had not benefited directly—from increased crop yields or decreased rates of disease—from the use of DDT. All of this, of course, the result of a single insecticide. We haven't even mentioned more than 80,000 other artificial products which soon joined and often surpassed this "wonder compound."

There can be no question about the miraculous revolution produced by insecticides. But it's necessary to point out that that revolution has not been accomplished without its complications. After all, insecticides, fungicides, and herbicides are *poisons*. Once released into the environment, their total effect may be hard to determine. The most direct effect may come from insecticide residues left on fruits and vegetables sold on the market. Farm goods are almost always washed before going on sale. Still it is difficult, if not impossible, to remove all traces of these poisons from the products they protected. Federal and state laws specify a certain maximum residue which may remain on the product and still have it regarded as "safe" for human consumption. The point is that this residue is almost always greater than zero. Thus, it's easy to see how pesticide poisons might well accumulate within a human body. This is especially true of chlorinated organics, like DDT, which are insoluble in water, but highly soluble in fats (like those in our bodies).

Humans are not the only animals who fall heir to pesticide residues. Birds and small animals that feed on lands sprayed with insecticides or herbicides are almost certain to pick up remnants of these poisons. And the effect on the smaller bodies of these animals may be quite a bit more severe than it is on humans. A number of studies of birds, fishes, rodents, and small mammals have begun to point up these effects. The thickness of shells of birds' eggs has been shown to be inversely related to the amount of DDT found in them. That is, the more DDT birds ingest, the thinner the shells of the eggs they lay. And thinner eggshells seem to result in fewer chicks being hatched and fewer newborn chicks surviving. In another study of the persistence of DDT in wild mammals in the United States, two scientists found residues of the pesticide in moles, shrews, and mice remaining as long as nine years after it had been sprayed in a forest at the rate of one pound per acre. Studies like this have, by this time, been repeated many times over. There is now scarcely any doubt about the murderous effects of many pesticides on fish, bird, and animal populations.

For all the direct threat of pesticides on human health and animal survival, there is yet a more serious problem associated with the use of pesticides. Imagine that DDT is sprayed on a field to eliminate corn borers. All but a very few borers are killed by the poison. Those which do survive, of course, are a little stronger, more resistant to DDT than were their unfortunate cousins. When these survivors breed and reproduce, the next generation of corn borers will inherit the "toughness" of their parents and be a bit more resistant to DDT. After a second spray, the whole process will be repeated. And, in fact, after each spray and with the birth of each new generation, resistance to the insecticide increases. Finally, the compound may be totally ineffective in killing corn borers. This, in fact, is just what has happened over and over again with DDT and with most other pesticides. The more they're used, the stronger become the bugs they're intended to fight. Since humans have never been successful in eliminating a single species of insects, the only real, long-range effect of using pesticides is to create a group of enormously strong, resistant species of insects. The more we fight pests with these chemicals, the tougher the battle becomes!

Is there any hope at all, then, in our war against pests? Biologists have developed other techniques for combating our insect enemies. One of the most effective, in the long run, may be biological controls. That is, one way to fight pest A is to find some animal, B, in nature, which is a natural enemy of A. Then, by turning B loose in fields from which we want to eliminate A, nature may do the job for us. The cabbage looper, for

example, is an insect that attacks lettuce, cauliflower, broccoli, and, of course, cabbage. In preference to using chemical insecticides, it is now possible to introduce a virus or a bacterium that is a natural enemy of the looper. Either will infect and destroy the cabbage looper without doing any damage to the plants they're attacking.

A similar technique involves the use of chemical attractants for pests. It is well known that many animals, including insects, signal and attract each other for sexual purposes by releasing small quantities of strong-smelling chemical compounds, *attractants*. If these attractants can be produced artificially, they can then be used as lures and placed in fields to attract undesirable insects. If the lures also contain poisons, the insects will be killed without contaminating the crop.

A final method which is being used in the control of pests is the sterilization process. The concept is simple. If a large number of males or females who mate in any particular generation is sterile, the population of the next generation is greatly reduced in size. And if this process is repeated for a few generations, the organism may soon die out. An example of one application of this principle was the 1959 program to eradicate the screwworm fly. At the outset, millions of fly eggs were collected on screens and nourished until the larvae emerged and became pupae. The pupae were then irradiated with a cobalt-60 source strong enough to sterilize them, but not strong enough to kill or injure the adult flies. At adulthood, the adult screwworm flies were released by planes over an area infected with other screwworm flies. When these sterile flies mated with normal flies, very few progeny were produced. The result of this particular program was a savings of over $25 million for ranchers in the southwestern United States. Development of one of these more "natural" techniques—biological controls, sex attractants, or sterilization—would provide an attractive alternative to our presently inadequate program of using chemical insecticides.

Case Study: Dilemma of a dedicated ecologist

Mr. Jenkinson has decided to give up life in the dangerous, polluted city he has lived in for nearly twenty years. He's made up his mind to turn to the simple life of the farm and the country. To that end, he recently purchased an 800-acre apple farm in western New York state. Somewhat to his surprise, Jenkinson has learned that farming is not quite the simple, straightforward career he thought it might be. Hard work alone will not, apparently, be enough. Extension agents in the area have informed Mr. Jenkinson that successful operation of the farm will require a good deal of modern, expensive machinery, extensive use of fertilizers, and generous use of pesticides. The land has been treated with fertilizers and pesticides so long that it's no longer possible to grow crops profitably without these artificial aids.

One of the fungicides specifically recommended to Mr. Jenkinson is a chemical called Captan. This substance has been found to be extremely useful in killing off pests and diseases, and in a recent peak year (1966), over 7.5 million pounds of Captan were used on more than fifty different farm crops, primarily fruits and vegetables. Captan is apparently just the right compound for Mr. Jenkinson to use in protecting his apple trees from insects and other pests and diseases.

Mr. Jenkinson is quite concerned, however, about the impact of his farming methods on the ecology of the area in which he lives. He's decided to find out as much as he can, therefore, about the artificial substances he'll use on his farm. He's already disturbed to learn that a fairly high proportion of his fertilizer is liable to wash off the land and drain into the community water supply. That not only contributes to the pollution of local lakes and streams, but also presents a certain threat to the health of his neighbors. The information he's received on Captan is not much more encouraging. The compound, first of all, is relatively hard to remove from the harvested fruit. This means that the danger of his fruit arriving at the market with significant amounts of Captan still on it is quite high.

Perhaps this is not a serious problem, however, since the United States government has established the tolerance level for Captan (the point below which no damage to health is expected) at 100 parts per million (ppm), and that's the highest value for *any* synthetic organic fungicide. That seems to indicate that the government regards Captan as relatively safe. On the other hand, Mr. Jenkinson has read that the chemical structure of Captan is similar to that of thalidomide, a drug which, in the late 1950s and early 1960s, produced hundreds of deformed children. Furthermore, although research with Captan on experimental animals is highly contradictory, at least some studies have shown that small amounts of Captan in an animal's diet may cause females to have lower average litter sizes, an increased rate of stillborn young, and a higher number of malformed offspring. No one has been able to explain the contradictory and uncertain results obtained so far, although some researchers think that some strains of animals apparently react to different dosages in different ways. Given this

collection of information, Mr. Jenkinson is not certain exactly what the "right" decision is about the use of Captan on his orchards.

The Buck Stops Here

If you were Mr. Jenkinson, would you use Captan on your apple orchard or not? Explain your answer.

Additional Questions

1. Barry Commoner has called fertilizers and insecticides the "perfect product" for a salesperson because the more you use of them, the more you *have* to use them later. Can you explain, for pesticides, why this would be so? See if you can find out why it would also apply to the use of fertilizers.

2. There seems to be not a single documented case of a human dying because of accidental poisoning by DDT. Yet that pesticide has been banned almost completely in the United States and in certain other countries of the world. How can this action be justified in view of its apparent safety for humans?

3. What arguments can you think of *against* the use of biological controls, sterilization, and sex attractants as a means of pest control?

4. As a citizen of the small town five miles from Mr. Jenkinson's farm, what would be your reaction to his use of Captan?

5. Resolved: There should be no governmental (federal, state, or local) control on the use of pesticides. Present arguments both for and against this proposition from the following standpoints: economic, ecological, political, social, and ethical.

6. Toghania is a West African nation with a high rate of death from tropical disease and severe nutritional problems from inadequate food supplies. The use of DDT in Toghania would almost certainly help solve both of these problems. How, if at all, would the question of using or not using DDT be different for the government of Toghania than it was for the government of Sweden or the United States?

7. DDT was banned from use in the United States in 1972. Studies carried out in 1986 showed that levels of DDT in parts of San Francisco Bay were still very high. In some locations, these concentrations exceeded 10 parts per million (ppm), twice the amount considered by the Food and Drug Administration as safe for human consumption. At a few isolated "hot spots" the concentration of DDT was 80,000 ppm. What implications (if any) do these findings have for your stand on the case study? For a national policy on the use of pesticides?

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Topic seven
Better babies on demand: Genetic engineering

Introduction

Brave New World is a famous novel by Aldous Huxley that tells of a society in which babies are conceived in test tubes and raised under controlled conditions to be exactly the kind of men and women the government wants them to be. How many years will it be before this book is moved from the "fiction" shelves in the library to the "nonfiction" shelves? Certainly, progress in genetic research in the past decade has made that a fair question to ask.

Not that we have a secret society of scientists out to find ways to "invent" or "manufacture" human life. If such men and women exist, they must constitute a small minority of scientific workers. Nonetheless, knowledge gained in many forms of "pure" research is rapidly progressing and accumulating to the point that the possibilities for "creating" human life are too obvious to ignore.

The aim of "pure" or basic research is never to solve specific technical problems (although such solutions often do come about as the result of discoveries in basic research), but to find out as much as possible about the nature of our physical world . . . to advance the frontiers of knowledge. Much basic research in biology has recently been directed at understanding the structure and function of the fundamental molecules that make up living systems. Of special interest has

A researcher from the United States Department of Agriculture stands in front of a model of a nucleic acid molecule. Find out some of the practical applications in the field of agriculture that might develop from an improved knowledge of nucleic acid structure. (photo courtesy of USDA)

been research into the nature and behavior of genes.

Historically, geneticists have explained the transmission of certain characteristics (like hair and eye color) from generation to generation on the basis of "chromosomes" and "genes." We have been able to take pictures of chromosomes, so we know what they look like and how they behave. But no one had ever seen a "gene" until recently, so there was much discussion as to exactly what a gene was. Then, a series of breakthroughs in biochemical research moved the whole study of genetics off into a quite different direction. Beginning in the 1950s research seemed to show that a particular class of compounds found in the nuclei of cells was all-important in passing on genetic information. These compounds are called the deoxyribonucleic acids, or DNA for short.

Each DNA molecule is made up of a long backbone of sugar fragments bound together by phosphate groups. Hooked on to this backbone at regular intervals are combinations of four organic "bases," guanine, cytosine, adenine, and thymine. The whole molecule looks something like this:

```
    |
  A—S
    |
    P
    |
  T—S
    |
    P
    |
  T—S
    |
    P
    |
  G—S
    |
    P
    |
  C—S
    |
    P
    |
  G—S
    |
    P
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. . . except that each molecule consists of a pair of strands like this one, a pair which is twisted around itself in the shape of a double helix, like this:

Figure 2

Scientists now believe that DNA molecules in an organism's body carry the "recipes" which tell the body how to make all the things it needs to make and do the things it needs to do. Even simpler than that, it seems to be the arrangement of bases which make up the genetic code. Thus, the combination:
— C — T — C — T — A — G —
might mean, to a cell, "make red hair," while the arrangement:
— C — T — T — T — A — C —might mean "make black hair."

As incomplete and hesitant as our understanding of molecular genetics still may be, we already have learned some quite remarkable things. Studies of genetic disease are an example. A genetic disease is some bodily disorder or dysfunction which a person inherits from his or her parents. Diabetes, for example, is a disease in which a person's body is unable to metabolize sugar properly. The necessary biochemical

mechanisms the body needs to process sugar were, apparently, just never "born into" the diabetic. One important piece of evidence that diabetes may be a *genetic* illness is the regular pattern with which it shows up in certain families, but not in others.

Scientists now believe that the kind of genetic disorder many diabetics have may be nothing more nor less than an error in the genetic code—the DNA—in that person's body. For example, instead of having a DNA segment reading, say, — C — G — G — T — A — (meaning "metabolize sugar"), the diabetic may have an error that reads — C — C — G — T — A —. The body then has no directions for performing the functions it's supposed to . . . like metabolizing sugar. Remarkably, scientists have actually *found* the specific errors which account for certain genetic diseases. Sickle-cell anemia, for instance, is an inherited disease among Africans and American blacks. It results when red blood cells collapse to form crescent-shaped bodies rather than normal, spherical ones. Research now indicates that "sickling" occurs because of an error in one segment of the hemoglobin molecules in the body. Instead of reading: -proline-glutamic acid- glutamic acid-lysine-, as it should, the incorrect message reads: -proline-valine-glutamic acid-lysine. This one difference among hundreds or thousands of amino acid groups results in the sickling effect.

The benefits of this kind of research are obvious. Since a specific illness can be traced to a specific physical situation it should be relatively easy to correct that illness by an appropriate physical action. In the case of sickle-cell anemia, as an example, it should be possible to cure the disease simply by removing the incorrect "valine" group and replacing it with a correct "glutamic acid" group. While this type of genetic surgery has not yet been performed, there is no

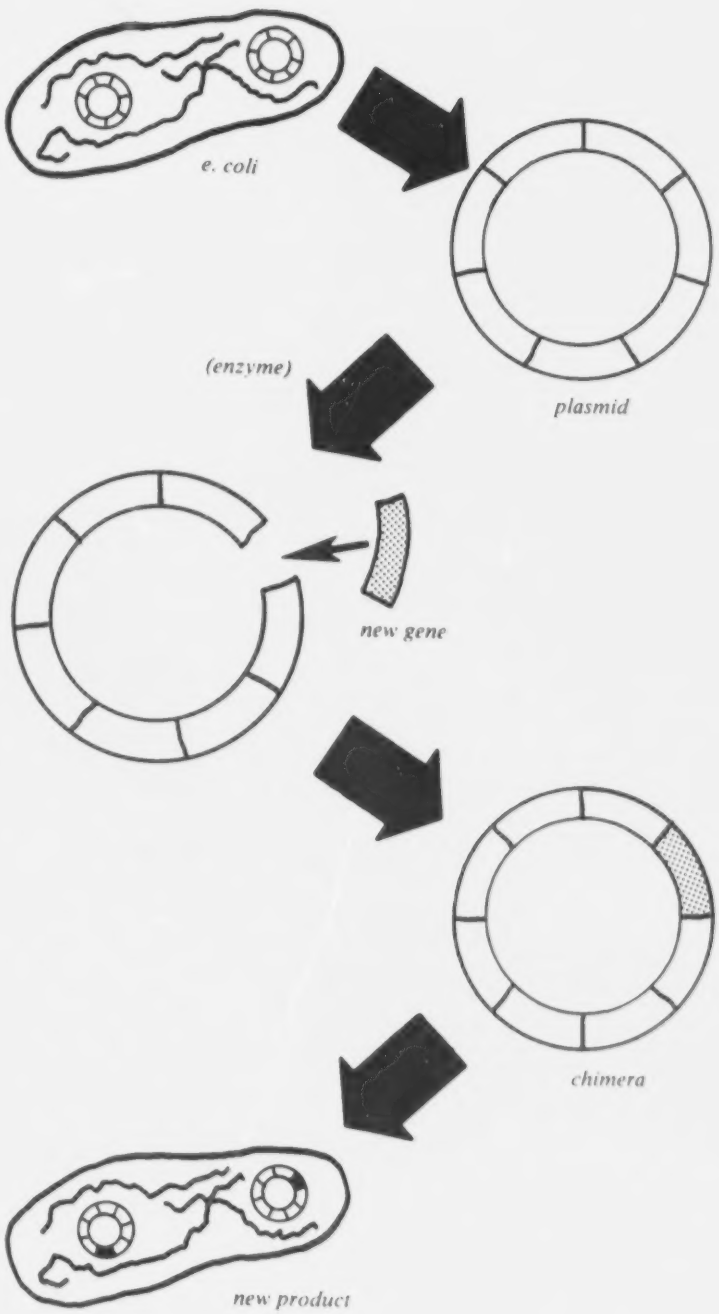

Figure 3

theoretical reason it *couldn't* be, and fairly soon.

There is, moreover, an interesting "angle" to this kind of research. If we have methods for correcting defects in the genetic code which produce disease, what is to prevent us from going further and changing *any* part of the genetic message we want to? That is, suppose a woman discovered that the child she is carrying will have green eyes, and she much prefers blue eyes. What is to prevent her from asking for genetic surgery that would substitute "blue eye" genes for "green eye" genes? From a technical standpoint, there is nothing. The long-range implication of this whole argument is that, before too long, it should be possible to have babies produced "on order"; that is, with whatever characteristics the parents may want. Whether that type of service *should* be available is another question.

The technique for making genetic changes is known as recombinant DNA. Most research of this type makes use of the bacterium *E. coli*, a microorganism found in the human intestine. *E. coli* is a useful research organism because its DNA is stored in two different forms. One form is made up of long, complex chains of thousands of genes, like the DNA of higher organisms. The other form, called *plasmids*, consists of relatively simple loops of a small number of genes.

The first step in a recombinant DNA change is to remove both forms of DNA from a sample of bacteria and separate the two from each other. (See Figure 3.) Then, highly specific enzymes are used to cleave (cut open) the plasmid ring at some known site.

Next, the gene for the desired characteristic is added to the plasmid. At present, this gene must be obtained from some natural source (plant or animal) that contains it. But it may be possible in the future to manufacture synthetically the genes to be added.

Finally, the reconstituted plasmids (now called *chimeras*) are mixed with normal *E. coli* bacteria. By carefully manipulating conditions, it's possible to get the normal bacteria to incorporate the chimeras into their nuclei.

Once in place, the recombinant DNA molecules will begin to direct the manufacture of the new characteristic prescribed by the new gene.

Important changes will have to be made in this process before it can be adapted to the manipulation of human DNA. Some scientists wonder if the process may be too difficult ever to accomplish. Others, while recognizing the difficulty of the task, think it is certainly not impossible and will be achieved eventually.

The process of recombinant DNA research is relatively simple *in concept*. Learning how to make these changes *in practice*, however, has turned out to be very difficult. Nonetheless, progress in the field has been—and promises to continue to be—surprisingly rapid. The scientific and economic rewards to those who succeed with recombinant DNA research are likely to be spectacular. Because progress in this field is so rapid, you will need to find out what the current state of affairs is at the time you read this case.

From the moment recombinant DNA research became a reality, scientists have been concerned about the social and ethical implications of their work in this field. What were the chances, they asked, for example, of producing an entirely new kind of organism? And what if this organism were toxic to humans? And what if the organism were accidentally released from a laboratory? If all these conditions existed, there might be no way to stem a horrible epidemic that would take countless human lives.

Thus, the first few years of recombinant DNA research saw soul-searching and efforts at self-regulation such as had never previously taken place in science. You should read something from the Background Reading section about the state of affairs in the early 1970s and again in the early 1980s.

As more and more successes in recombinant DNA research were attained, many scientists shifted their attention from social and ethical questions to economic horizons. By the end of the 1970s, it became obvious that recombinant DNA was going to produce organisms that would revolutionize medical and health care, agriculture, industrial processes, and who knows how many other fields. As a result biotechnology corporations were formed by the dozen to put the procedures of genetic engineering to work in producing new drugs, plant forms, fuels and other products. Again, be sure that you read something about this explosion in biotechnology in the *Background Reading List*.

Scientists began to play two roles: researcher and business person. New knowledge gained in the laboratory was put to use almost immediately in the world of business and industry.

The case study that follows raises a number of the issues we have been discussing in this introduction. These include ethical questions (such as the responsibility a scientist has for the uses to which his or her discoveries and inventions are put by society); social questions (such as the mechanisms by which control—if any—over scientific and technological discoveries is to be exercised); political questions (such as with whom the decision-making authority rests in issues like this

one); and economic issues (such as the mechanism by which a controversial, but potentially very profitable discovery can or should be marketed). *The Buck Stops Here* challenge for this case is fairly open-ended, allowing you to consider as wide a range of these issues as you can.

Technically, the case assumes certain scientific techniques that are not now available, and may not be for some years. For the sake of argument, assume that these techniques eventually *will* be developed. Then, in your analysis of the case, concentrate on social, political, economic, and ethical aspects of the question.

Case Study: Human characteristics to order

Professor Augustus Worthy has been engaged in genetic research at Sterling University for almost thirty years. Recently his special area of interest has been deciphering the DNA code for "handedness" in humans. Dr. Worthy believes that a person becomes either right-handed or left-handed because of two factors that interact with each other, one of which is genetic and the other environmental. The genetic factor results from a particular arrangement of bases in the DNA molecule that predisposes the individual to be either right-or left-handed. This factor, which produces only a *tendency*, and not a definite commitment, can be definitely established through biochemical analysis of DNA structure.

The second factor is environmental in the sense that, no matter what the genetic code may be, *any* person can be brought up to be *either* right- *or* left-handed if the surrounding conditions are correct. That is, a child who early begins to show tendencies of being right-handed can be forced to become left-handed by parents who want to make this change badly enough. Of course, there may be the possibility of certain psychological damage from a program like this.

Dr. Worthy's research has convinced him that he has been able to pinpoint the exact genetic code for right-and left-handedness and that he is capable of performing the kind of genetic surgery that would allow parents to choose right- or left-handedness for their prospective offspring. Essentially, this involves removing a sample of bodily fluids from the fetus while it is still in the mother's womb, "correcting" the DNA structure by chemical means, and then returning the fluids to the fetus. There is no reason to expect any harmful physical effects from this type of operation.

Dr. Worthy intends to patent the technique he has developed and to establish a corporation to market the procedure. The new company, Handi-Gen, would hold sole rights to the use of this technique and to the licensing of other companies desiring to use it.

The Buck Stops Here

You are serving on the faculty advisory council at Sterling University. The council's job is to assess possible social implication of faculty research. You are not an expert in chemistry, genetics, law, or economics. You are simply an intelligent, reasonably well-informed, concerned faculty member. Based on what you know thus far, what recommendations would you make (to Dr. Worthy, to Sterling University, to the Patent Office, to the general public, etc.) about Dr. Worthy's invention?

Additional Questions

1. From your background reading for this case, list (1) some results already achieved by recombinant DNA research (2) some accomplishments that seem possible in the near future, and (3) some achievements that may be realized after the year 2000.

2. For each item listed in Question 1, try to identify a social, political, economic, or ethical problem created by the achievement.

3. Who, other than Dr. Worthy, should help determine the use to which his discovery is put? If you say "no one," explain why.

4. Are there any *ethical* problems in Dr. Worthy's establishing a corporation to market the discoveries he has made? Why or why not?

5. Your answer to *The Buck Stops Here* for this case study was based on a somewhat trivial matter of determining "handedness." Assume that genetic techniques for producing each of the following becomes *technically* possible. Tell, for each, whether you think the technique would be: (1) desirable; all efforts should be made to see that it is available to the general public; (2) acceptable; not something I'm delighted to see in practice, but something to which the general public has a right to know about and use; (3) unacceptable; the social risks presented by the technique are too great to allow the general public to know about and use.

   Techniques:

   a. cure for diabetes

   b. automatic immunity to syphillis

   c. color of child's hair

d. intelligence

e. musical ability

f. level of aggressiveness

g. cloning of humans

h. production of human life outside of the human body

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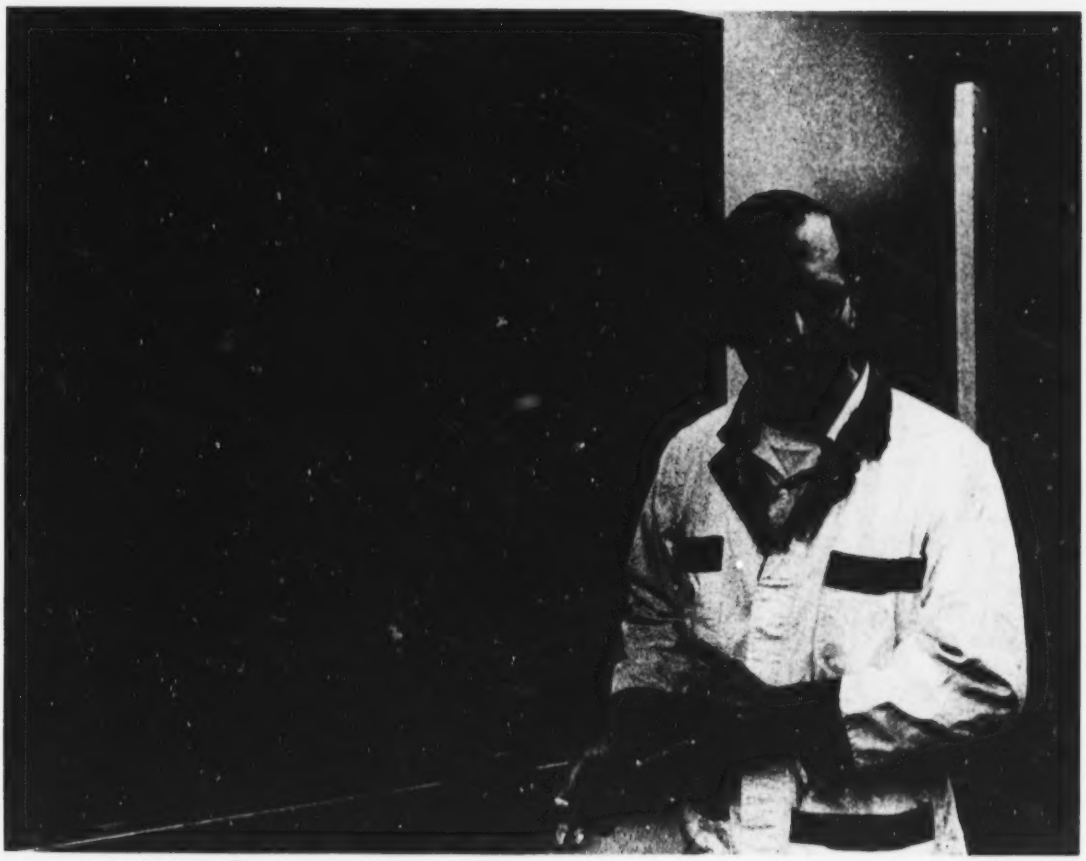

Scientists are now dealing with the most fundamental of all questions, "What does it mean to be 'human'?" We are approaching the point at which we can manufacture parts of living organisms. Is there a point at which society should say to scientists: "Enough. You can do no more research beyond this point."? If your answer to this question is yes, explain how you would enforce such a rule. If your answer is no, explain how society should handle the difficult social, political, and ethical problems that are likely to arise from this kind of research. (photo courtesy of U.S. Atomic Energy Commission [*DOE*])

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Topic eight What kind of society would you like? Behavior modification

Introduction

How ought humans to behave? How can we *make* them behave the way they should? These questions have been asked since the origins of civilization. They show up over and over again, from the most fundamental of contexts to the most trivial.

"I want that man to be my slave and serve me."

"That woman should become my wife and spend her life satisfying my needs."

"Students must learn to come to school on time."

Behavior modification techniques can be used to help children with learning problems. Is this a "good" or "bad" application of these techniques? They might also be used to teach children to appreciate classical music. Would that be a "good" or "bad" application of the techniques? They might also be used to teach children to be more patriotic. Would that be a "good" or "bad" application of the technique? Explain your answer in each case. (photo courtesy of Medical Center News Bureau, Stanford University)

"When the flag passes by, all citizens must stand and salute."

"A man can have no more than one wife at a time."

Getting humans to behave the way "they should" is technically called *behavior modification*. The process of shaping human behavior is one of the most pervasive and basic of all social phenomena. Think of all the ways in which your parents, the schools, government, industry, the media, and other social forces around try to shape your behavior. Most of us are exposed to behavior modification almost every waking hour of every day of our life. Indeed it might be argued that the process of growing up is nothing other than a complex set of behavior modification programs working to shape what we think and do.

If behavior modification has always been such a fundamental part of human civilization, why bother with it in a book like this? Shaping human behavior is, almost by definition, what human societies are all about; so why worry about it? The answer to that question is found in the second question that opens this introduction: "How do we *make* people behave the way they should?" For most of human history the techniques used in behavior modification were quite crude. A slave was chained to his or her workplace or punished if he or she tried to escape. Students who were late to school were made to stay after school. Men who had more than one wife were put into jail.

In recent years, the methods available for behavior modification have become much more sophisticated. They make use of inventions and discoveries from science and technology. They tend to be both more elegant and more subtle, and much more effective. It is this application of science and technology to the control of human behavior that makes the subject of behavior modification a legitimate and important topic for this book.

Most people believe that human behavior is determined by two factors: heredity and environment. The kind of person you are depends both on the genes you inherited and the way you've been brought up. In that respect, genetic engineering may be thought of as one form of behavior modification. In the cases that follow, however, we focus on things that can be done to a person *after* birth. These include:

1. psychosurgery
2. electrical stimulation of the brain
3. electroconvulsive shock therapy
4. psychological conditioning
5. drug therapy

We will examine each of these in more detail in the cases that follow.

Psychosurgery

Perhaps the most dramatic method of controlling human behavior is brain surgery. Humans have known for thousands of years that behavior is controlled by the brain and changes in behavior can be brought about by operating on the brain. For example, the surgical removal of brain tumors was an operation known to ancient Egyptians and the Incas more than 3,000 years ago. In the process of *trepanning* a section of the skull was removed to permit surgery directly on the brain itself. This allowed the physician to correct abnormal behavior resulting from the tumor.

The use of brain surgery to modify human behavior ("psychosurgery") really has its modern beginnings in the 1930s. Research on experimental animals had shown

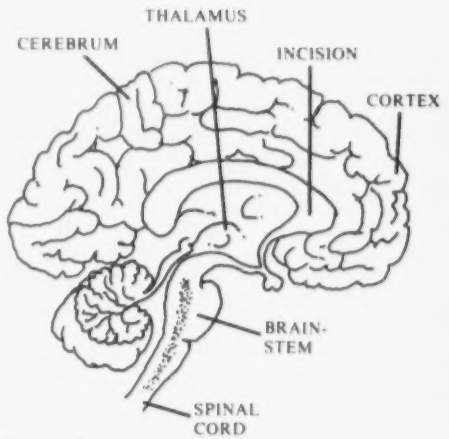

Figure 4

that severing the nerves that connected the frontal lobes from the rest of the brain (See Figure 4) would produce dramatic changes in behavior. Animals that were normally nervous or aggressive became calm and unemotional after this operation.

In 1935, a Portuguese surgeon, Antonio de Egas Moniz, developed techniques for the use of this operation—called lobotomy—on humans. His hope was to provide relief for patients with severe emotional distress. Egas Moniz's surgical technique was greatly simplified by the American neurologist Walter Freeman in 1946. The new procedure could be done by any trained physician and became widely popular over the next decade. Some estimates placed the number of lobotomies performed at more than 50,000 in the 1940s and 1950s.

One reason for the operation's popularity was the ease with which it solved otherwise difficult problems. It brought relief from pain to many patients. And for those with severe mental or emotional disorders, lobotomy provided a fast, efficient, relatively inexpensive relief from their mental problems.

The difficulty was that a number of serious side effects resulted from the operation. Some patients became apathetic and unresponsive to their environment. In many cases, they were little more than "human vegetables." At other times the operation resulted in wild, uncontrolled behavior accompanied by fits, seizures, and loss of control over bodily functions. By the end of the 1950s, most physicians had decided that lobotomy was too unreliable and too dangerous a procedure for the purposes for which it had been intended.

Although the number of prefrontal lobotomies was drastically reduced after 1955, the controversy surrounding this procedure did not disappear. Animal research and a small number of operations on humans continued. Critics, most notable of whom was the Washington, D.C., psychiatrist Peter Breggin, urged a complete ban on all psychosurgery in the United States. Partly as a result of Breggin's efforts, a special study by the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research was ordered in 1975.

The report of the commission was issued in the fall of 1976. It found that techniques for psychosurgery had become much more sophisticated. The rather crude methods of the '40s and '50s were no longer advised or used by physicians. Techniques used in the 1970s were found generally to bring relief from pain or severe depression without the terrible side effects of earlier operations. Even members of the commission who began with negative attitudes about psychosurgery ended up supporting its use for many purposes.

The commission's report certainly did not end the controversy about psychosurgery, however. For one thing, it found that no one quite knows *how* the procedure works (i.e., how it affects the brain). Some feel that its success is purely psychological, brought about by special personal factors in the doctor-patient relationship. The lack of research on the methods used was also a source of concern among commission members.

There is still some concern about the circumstances in which psychosurgery should be used. There's little doubt that it should be tried when no other method is available for relieving severe pain. But how often should it be applied to mental or emotional difficulties, like neuroses, psychoses, and phobias? This raises difficult problems of deciding what it is that constitutes a "mental illness." Some critics remember the recommendation made by a group of three physicians in the late 1960s to use psychosurgery on the leaders of the civil rights riots of those years. The possibility of *defining* civil disobedience as an emotional problem and then "curing" it by psychosurgery is certainly a real one.

Finally, the problem of "informed consent" is another consideration. Some individuals who might *need* the kind of help offered by psychosurgery are those least able to agree to its use. Should we perform an operation like this without a person's knowing what is going to happen and agreeing to allow the procedure? The following case study provides a specific example of the problems surrounding the use of psychosurgery.

Case Study: Psychosurgery

X is presently an inmate at the Rolling Hills State Hospital for the Criminally Insane. He is serving a six-year term for child molestation. This is X's third conviction for the same offense. During the past ten years, he has been in prison, the State hospital, or on probation for sex offenses a total of nine years and four months.

X has been under intensive study and care by the hospital's chief psychiatrist for the past six months. During this time he has received psychological counseling, drug therapy, and electroconvulsive shock therapy. The psychiatrist reports that none of these treatments appears to have been effective in resolving X's problems. At this point, she recommends a surgical procedure to eliminate X's sex drive by destroying a portion of the posterior hypothalamus, which controls sex drive. The operation is simple, quick, and irreversible.

Experts probably cannot predict all possible consequences of the operation, the psychiatrist reports. In fact, one reason for performing the procedure might be to learn more about these effects, she explains. As far as "informed consent" is concerned, her position is: "These men have no rights; if we can learn something by using them [for medical and surgical experiments], then that is small compensation for the trouble they have caused society."*

The Buck Stops Here

You are a lay member of the state hospital's advisory board. Would you vote to approve or disapprove psychosurgery for X?

Additional Questions

1. Based on your readings for this case study, list some situations in which you think psychosurgery is definitely appropriate; some in which it is a possibility; some in which it should be prohibited. If you decide there

*This comment was attributed to a medical researcher at Atascadero State Hospital in California in connection with the hospital's treatments of convicted sex offenders.

are no examples of one or more of these categories, explain why.

2. Is there any situation in which psychosurgery should be *withheld* from a patient who freely volunteers for this procedure? Is there any situation in which the procedure should be forced on someone who chooses *not* to have it? Try to imagine examples of each.

3. What technical improvements have made psychosurgery more acceptable today than it was thirty years ago?

4. Some critics have argued that the use of psychosurgery reflects racist, sexist, and/or class biases. If statistics actually *did* show that blacks, women, and the poor were more often the subject of brain surgery, would this conclusion be justified? Explain your answer.

5. Identifying and treating *physical* illness is a fairly objective process. Identifying and treating *mental* illness tends to be a far more subjective process. Explain what this means. What significance does this have for the use of psychosurgical procedures?

6. Comment on the final sentence of the case study. Explain why you agree or disagree with the sentiment expressed there.

Electrical stimulation of the brain (ESB)

Two other techniques of behavioral control make use of direct intervention in the human brain. These are electrical stimulation of the brain (ESB) and electroconvulsive shock therapy (ECT). Both procedures are based on discoveries made in the early 1920s. A German physician, Hans Berger, found that activities in the brain were accompanied by electric currents. By attaching electrodes to the scalp, Berger was able to measure the currents associated with seeing, speaking, moving, thinking, feeling, and other human activities. It was an enormously important discovery that the previously mysterious phenomena of human behavior could be expressed in the concrete form of electrical signals!

It didn't take long for scientists to realize the consequences of this discovery. If physical, mental, and emotional functions were nothing other than electrical phenomena, it should be possible to influence human thoughts, acts, and feelings from the outside by electrical stimulation. In fact, experiments of this type were initiated within a few years of the announcement of Berger's discoveries.

At first, the research was not very sophisticated. Electrodes were inserted into the brains of experimental animals and electrical messages transmitted at random. Scientists weren't very sure what might happen: an animal might demonstrate hunger, fear, aggression, boredom, or any other behavior or emotion. Gradually, researchers began to identify the ways in which very specific parts of the brain were responsible for very specific physical, mental or emotional functions. Stimulation of a particular part of a cat's brain might cause it to go to sleep, while stimulation of another point only a few millimeters away might cause it to urinate.

Perhaps the most famous proponent of ESB is Dr. José M.R. Delgado. Delgado's research on ESB spans nearly half a century, during which time he has moved from studies of cats and monkeys to research on humans. He points out that ESB has been shown to be effective in treating brain-related problems such as schizophrenia, epilepsy, and Parkinson's disease. Based on these successes, there is no reason that ESB could not be used to treat a much broader range of human mental problems: neuroses, psychoses, violent behavior, and other "undesirable" forms of human behavior could be brought under control by ESB, he believes.

The technique might go something like this: Suppose a person has an abnormal and uncontrollable fear of cats. A possible form of treatment might be to implant a tiny transmitter-receiver in the person's brain. The miniaturization of electronic equipment now makes this a technically feasible operation. Then, when the person encountered a cat, the brain would send out "fear" signals. These electrical impulses would be transmitted to a "controller" somewhere. The controller—a computer, for example—would read the incoming signals, interpret them, and send out a new signal to the implanted electrode. The signal would be directed to a part of the brain telling the person to "calm down." By means of this process, nearly any "undesirable" form of human behavior could be controlled.

Case Study

The President's Special Commission on Crime has prepared its final report. Recommendation A3 concerns the problem of repeat offenders. Existing penal methods seem to be almost totally ineffective, the commission has decided. Over 80 percent of all released prisoners are arrested, convicted, and returned to prison within eighteen months. One method to reduce this problem, the commission has decided, is to monitor more closely the behavior of released criminals.

The recommendation they've agreed upon is reproduced here:

Recommendation A3:
Repeat offenders

1. This recommendation concerns any prisoner who has been incarcerated at least three times or for a period of at least five years.

2. Upon release from prison, every offender shall have implanted a tiny radio receiver-transmitter. Present technology allows the implantation of such a device that would be no larger than a small thumbtack. No discomfort would be experienced by the subject either during the operation or during the time he or she is carrying it.

3. Intentions to commit antisocial behavior could be read by the implanted device and transmitted to the state's central computer. The computer would have been programmed to read, interpret, and respond to brain wave patterns in each released prisoner.

4. If the computer interprets an incoming signal as a possible act of antisocial behavior, it would transmit an electrical signal to the implanted device. The signal would simultaneously reduce the desire to commit antisocial behavior and induce a sensation of pain. The deviant person would be punished even for thinking about the improper behavior.

5. Any individual who demonstrates good behavior for a period of at least one year may have the electronic device removed upon recommendation of his or her parole officer.

The Buck Stops Here

You serve on the League of Women Voters' committee on legislative action. The committee has been asked to prepare a statement on the Presidential Commission's plan. Working with other students who also serve on the LWV committee, write a brief analysis of the commission's Recommendation A3.

Additional Questions

1. The development of microprocessors opens many new opportunities in ESB research. If you don't know what microprocessors are, obtain some minimal background information about them. Then try to imagine some ways in which they might be used, in conjunction with ESB techniques, to control human behavior in the future. Decide what the advantages and problems might be for each of the uses you invent.

2. Suppose that research in ESB eventually leads to the development of techniques which make it possible to control a vast range of human thoughts, behaviors, and emotions very precisely. For example, suppose it becomes possible to trigger the emotion "fear" simply by precise stimulation of a particular section of the brain. Who should be allowed to make use of these techniques? Any scientist who can learn how to use them? Government officials only? Medical doctors only? Explain the answer you develop for this question.

3. It might become technically possible to produce a very small "self-stimulator" for individual use. This device could be implanted in the "pleasure center" of the brain and activated by a person himself or herself. Any time the person wanted to "feel good," he or she could just push a button and stimulate the pleasure center in his or her own brain. Do you see any moral issues in the development and/or marketing of such a device? Why or why not?

4. ESB can obviously be used for either good or evil. In the society we live in, what can be done to be sure that it is used only for beneficial, and not for harmful, purposes?

5. The key phrase in the previous question may be, "in the society we live in." In what ways are the uses to which ESB is put determined by the kind of society that exists? Think of some examples that would support your answer. In what ways is the kind of society we live in *influenced by* the use of ESB? Try to think of some ways in which the community you live in might be changed by the more extensive use of ESB techniques.

6. In theory, ESB could be used to control each of the following human conditions: (1) epilepsy, (2) homicidal behavior, (3) shoplifting, (4) homosexual behavior, and (5) masturbation. The question here is not how you feel about the use of ESB in each of these examples, but *who* it is that should decide if, when, and how ESB should be used in *each* of the above examples.

Electroconvulsive shock therapy (ECT)

The use of electricity to treat medical problems goes back many centuries. We know that Greek and

Roman physicians, for example, used electric eels to relieve the pain of facial neuralgia. It was not until the present century, however, that modern techniques for electrical therapy were developed.

That therapy has generally been employed for two quite different purposes. One is the relief of pain which has not been successfully treated by any other method. That application is not one which we will consider in this section. The second application is for the control of behavior. Electroconvulsive shock therapy (ECT) has been widely used for three-quarters of a century to treat a wide range of mental disorders, emotional problems, and "abnormal" behaviors. It has been, that is, a popular method of behavior modification.

The peak interest in ECT may have occurred in the 1930s and 1940s. During that period physicians and psychiatrists became very enthusiastic about the ability of electric shock to modify many kinds of human behavior. It was employed to cure every manner of disorder, from cancer and asthma to brain tumors and multiple sclerosis to mental retardation and homosexuality. Even today ECT is very popular among psychiatrists, nearly nine out of ten approving its use for one or more psychiatric disorders.

Popular concern about ECT has become more widespread in the last few decades, however. In some ways this is easy to understand. The process itself is terribly traumatic. Before the careful use of restraints and muscle relaxants, ECT caused such severe convulsions that some patients experienced broken bones or serious bruises. For many the experience produced a loss of memory, reduced ability to perform intellectual tasks, and other forms of mental disruption. In some cases, people treated and "cured" by ECT emerged as little more than "human vegetables." Articles, reports, and books written by former ECT patients vividly portray the horror that may accompany this treatment. A number of organizations of ex-patients have been formed to monitor and/or protest the use of ECT.

The current status of ECT seems to be on the one hand a high level of popularity among professionals (i.e., psychiatrists) and on the other concern, reservations, disapproval, and/or horror among the general public about the use of this technique. More than any other method of behavior modification, ECT may raise the crucial question as to who knows best in a case like this? Should professionals whose job it is to understand and treat mental, emotional, and social disorders decide what proper treatment is? Or do laypersons have some role in this issue? Should the man or woman on the street have any input into the question of whether or not ECT should be used on mental patients? The case study that follows focuses on this question.

Case Study: Treating homosexual behavior

Sexual intercourse between two members of the same sex is illegal in your state. The offense is a felony for which conviction is penalized by an indeterminate sentence in the state hospital for sexual criminals. This means that a person convicted of homosexuality is to be confined to the state hospital until he or she is no longer homosexual.

Dr. Harly Barnsan, the chief psychiatrist at the state hospital, feels strongly that the only effective treatment for homosexual behavior is ECT. His standard procedure, therefore, is to prescribe a regular program of ECT treatments for all inmates convicted of homosexual behavior. Dr. Barnsan has no firm data on which to support his program of therapy. Scientific evidence suggests that sexual preference (homosexual or heterosexual) is very resistant to change and that there are few validated cases of successful, long-term changes from homosexual to heterosexual orientation (or vice versa).

Follow-up studies of Dr. Barnsan's patients indicate that many leave the state hospital with greatly reduced sex drives and appear to be much more readily managed. Few have been returned to the hospital as repeat offenders. Many have been unsuccessful in developing friendships or love relationships, but, in general, they have "stayed out of trouble." Based on these experiences, Dr. Barnsan intends to continue his use of ECT on his homosexual inmates.

The Buck Stops Here

Your favorite cousin has just been convicted of homosexual behavior and sentenced to a term at the state hospital. You are familiar with the facts outlined in the case study above and know what type of treatment program your cousin faces. What do you do?

Additional Questions

1. There seems to be almost no understanding of the way ESB and ECT "work." What does this imply, if anything, about the use of these techniques?

2. The text says that ECT has been used to relieve "pain which has not been successfully treated by any other method." Find out more about this use of ECT. Describe any ethical issues that you think may be involved in this type of therapy.

3. Network Against Psychiatric Assault is a group organized to work against the use of ECT, many of whose members are former patients. See what you can learn about this organization and/or others like it. What objections do these groups have to the use of ECT procedures? What responses do psychiatrists have to these objections?

4. "Psychiatrists know best how to treat mental patients in their care. If they decide that ECT is the best procedure to use for a particular individual, that is no one's business but the psychiatrist's." Comment on this argument.

5. Should an individual be able to decide whether or not ECT will be used on him or her? Under what circumstances would you say yes to this question? Under what circumstances would you say no?

6. Is psychiatry a "scientific" profession? This is a difficult and complex question. Do not attempt to answer it "off the top of your head." Consult the *Background Reading List* and become more familiar with the way psychiatrists work before trying to frame an answer.

Psychological conditioning

Late in the nineteenth century, the Russian physiologist Ivan Pavlov carried out some historic experiments on the behavior of dogs. In this research, Pavlov sounded a bell each time he fed a dog. He found that after a period of time, the sound of the bell apparently became associated with the presence of food for a dog. The dog would begin to salivate simply by hearing a bell, even if no food were present. Pavlov called this form of learning *conditioning*. The term means arranging the signals ("stimuli") an organism receives in such a way as to produce the behavior ("response") an experimenter wants.

From this simple beginning, the science of conditioning has grown to become a complex and sophisticated system for controlling animal (including human) behavior. The principle on which conditioning is based states that behavior which is rewarded is more likely to be repeated; that which is punished is less likely to be repeated. The job of an experimenter is to arrange conditions (stimuli) so that certain desirable behaviors (responses) appear, and then to reward (reinforce) those behaviors. Those situations in which undesirable behavior is punished is called *aversive conditioning*.

Psychologists have used conditioning procedures to produce some remarkable animal behaviors: pigeons have been trained, for example, to play Ping Pong, dance in figure eights, and feed themselves by pushing the right sequence of buttons. Of more interest to us, however, is the application of these techniques to the shaping of human behavior. The same methods by which a rat can be trained to run a maze can be applied to mental patients, prisoners, schoolchildren, and others whose behavior someone is trying to change.

In fact, it is among these three populations—inmates of mental institutions, prisoners, and students—that behavior modification techniques have been most widely used. The most humane and effective way of getting people to behave in socially correct ways, many psychologists argue, is to use positive reinforcement and/or aversive conditioning. In preparation for the case study below, you should find out what successes and failures conditioning has had.

Some psychologists see even more global applications of conditioning. They argue that human behavior is *nothing other than* the sum total of countless conditioning experiences from the moment a child is born until an individual dies. The problem, they say, is that most of this conditioning is thoughtless, unplanned, and uncontrolled. The way humans turn out is, therefore, left mostly to chance.

The way to achieve a more perfect human society, it follows, is to *arrange* the kind of conditioning to which individuals will be exposed. We should plan stimuli, reinforcements, and punishments so that people will respond in every aspect of their lives the way they ought to. The leading theorist and spokesperson for this philosophy has long been B.F. Skinner. You may want to see what Skinner has to say about his idea of a "perfect" human community (see the references to *Walden Two* in the background reading) and how Skinner's critics feel about his idea. The *Case Study* that follows is one psychologist's idea of the ways in which conditioning can be applied to the solution of one important social problem.

Case Study:

The Daily Item Vol. CXIII, No. 35

BRAINWASHING CAN MAKE CRIMINALS INTO GOOD CITIZENS, PSYCHOLOGIST SAYS

Behavior modification should be used to mold the kind of citizens we want, says McConnell

A new "treatment" for criminal behavior was recently proposed by University of Michigan psychologist, Dr. James V. McConnell. McConnell, a specialist in behavior modification techniques, suggested using "positive brainwashing" to correct deviant social behavior on the part of criminals.

"I believe that the day has come," Dr. McConnell argued, "when we can combine sensory deprivation with drugs, hypnosis and astute manipulation of reward and punishment to gain almost absolute control over an individual's behavior. It should be possible then to achieve a very rapid and highly effective type of positive brainwashing that would allow us to make dramatic changes in a person's behavior and personality. I foresee the day when we could convert the worst criminal into a decent, respectable citizen in a matter of a few months—or perhaps even less time than that."

McConnell sees a wide range of methods for dealing with antisocial behaviors. For misdemeanors or minor offenses, he recommends "brief, painless punishment, sufficient to stamp out the antisocial behavior." The committing of a felony, however, would be taken as "clear evidence that the criminal had somehow acquired full-blown social neuroses and needed to be cured, not punished. We'd send him to a rehabilitation center where he'd undergo positive brainwashing until we were quite sure he had become a law-abiding citizen who would not again commit an antisocial act. We'd probably have to restructure his entire personality."

The theoretical basis for Dr. McConnell's recommendations are found in the school of psychology known as behaviorism. Behavioral psychologists believe that the notion of "free will" among humans is archaic and inaccurate. Humans become what they are, behaviorists believe, as a result of myriad environmental factors that randomly shape a person's behavior.

"No one owns his own personality," McConnell says. "Your ego, or individuality, was forced on you by your genetic constitution and by the society in which you were born. You had no say about what kind of personality you acquired, and there's no reason to believe you should have the right to refuse to acquire a new personality if your old one is antisocial."

Dr. McConnell's suggestions raise some profound legal and ethical problems, as he readily admits. He points out that society "must begin by drafting new laws that will be as consonant as possible with all the human-behavior data that scientists have gathered. We should try to regulate human conduct by offering rewards for good behavior whenever possible instead of threatening punishment for breaches of the law. We should reshape our society so that we all would be trained from birth to want to do what society wants us to do. We have the techniques now to do it. Only by using them can we hope to maximize human potentiality."

Resolving the ethical issues inherent in this method of treating criminals will also be "frighteningly complex," Dr. McConnell acknowledges. However, "we know by now that there are no simple solutions," he points out, and by "knowing what is scientifically possible and by taking a revolutionary viewpoint toward society and its problems, we can surely shape the future more sanely than we can if we hide our collective heads in the sand and pretend it can't happen here."*

*This fictitious newspaper article is adapted from an article written by Dr. James V. McConnell in *Psychology Today*, April 1970. If at all possible, you should read this article in its complete and original form.

The Buck Stops Here

The warden of the Sunshine State Prison has just read Dr. McConnell's proposal for brainwashing criminals. He feels that the proposal may be a more effective, more humane method for preventing crime than any system he presently knows of. He is recommending to the state legislature, therefore, that a system for brainwashing criminals be developed, tried out, and evaluated at Sunshine. His budget request for the next fiscal year includes an item in the amount of $112,482 for this experimental program. As a legislative assistant to the legislature's committee on prisons and paroles, what position would you take on this recommendation? Explain why you would tend to favor or oppose the budget item for brainwashing.

Additional Questions

1. From articles in the *Background Reading List* or other reading, try to determine *how effective* the methods suggested by Dr. McConnell actually are. To what extent could we expect them to be as effective as he thinks they would be?

2. Conditioning has been used in the modification of many kinds of human behavior. Make a list of as many of these as you can locate. Then, select any one to study and report on in greater detail.

3. Consider forms of human behavior which are *not* legal matters. Some examples might be the foods one chooses to eat, the kind of work one chooses to do, and the person one chooses to marry or live with. Are there *any* circumstances under which behaviors like these should be subject to conditioning? If you say yes, tell what those circumstances are. If you say no, explain why not.

4. Teachers often condition their students. Students also condition their teachers. Give some examples of each. For the examples you choose, tell whether each is a "good" or a "bad" thing.

5. The argument of *Walden Two*, very simply put, is that people can be conditioned from their very youngest years to like to do, think, and believe certain things. Some can learn to like janitorial work, others to like being priests, and still others to like being artists. What makes for a happy, efficient society is for each person to enjoy doing whatever it is he or she was *trained* to like early in life. What is your opinion of this philosophy?

6. Assuming that conditioning of some kind *is* going on in our society, who should decide where, when, how and on whom that conditioning should be used? List at least half a dozen specific examples of social conditioning that do occur, and answer this question for each of your examples.

7. What does the term "free will" mean? Does free will really exist? Try to develop an argument that shows it does not. Then, try to refute your own argument. What difference in the real world does the answer to this question make?

8. Think of some specific examples of conditioning that have already taken place in your life. For each example you name tell (a) who did the conditioning (b) who decided the conditioning should be done (c) how the conditioning was accomplished (d) why (in your opinion) the conditioning took place (e) whether society is better or worse off as a result of the conditioning (f) whether you are better or worse off as a result of the conditioning.

9. Behavior modification techniques are perhaps most often suggested for individuals who display antisocial behavior.

This would include murderers, rapists, child-molesters, thieves, forgers, and exhibitionists. Which of the behavior modification techniques mentioned in this section (psychosurgery, ESB, ECT, drug therapy, or conditioning) do you think is *most appropriate* for each category of individuals listed above? Are any of the methods "totally unacceptable" or "always preferable"? Explain your answer.

Drug therapy

One of the great changes in biological research in recent years has been the extent to which chemical information is being used. More and more of the changes that take place in plants and animals (including humans) are explained on the basis of chemical reactions. Typical human behaviors such as anger, fear, sleep, passion, arousal, and even thought itself can now be described in chemical terms.

The implications of these discoveries are obvious: If many human behaviors are chemical in nature, they can be altered or controlled by chemical means. As a result, the last few decades have seen a greatly increased interest in finding ways to modify human behavior with chemicals (i.e., drugs). Of the many applications of drug therapy in use today, we turn our attention to one in particular: the use of chemicals to control adolescent behavior.

Adolescence may be one of the most difficult—if not *the* most difficult—period in a person's life. Boys and girls are going through that very difficult process of "growing up" which involves all kinds of physical, emotional, and social changes and adjustments. This is the period when sex changes begin. Boys and girls—now on their way to being men and women—have to learn to live with entirely new bodies. After ten, twelve, or fourteen years of getting used to "the person I am," teenagers suddenly must start all over and rediscover who they are and what their place in the world is to be.

This is a period when the unusual is commonplace. A teenager's behavior changes from day to day as he or she goes from old attitudes and behaviors that *used* to work to new attitudes and behaviors he or she is just learning to use. A student may be childlike and dependent one minute, mature and independent the next. It is little wonder that adolescence has often been called the period of "Sturm und Drang" (storm and stress) in a person's life!

Putting twenty-five to thirty-five active young men and women in a classroom, where they are expected to sit quietly and be well-behaved for hours at a time is, therefore, something like waving a red flag at a bull. For there is hardly any group of humans who should less be expected to remain motionless and attentive for long periods of time than teenagers.

If all this is true, then how should we view those students whom schools have labeled as "trouble-makers"? These are boys and girls who just don't seem to be able to adjust to the quiet, subdued routine of most classrooms. They tend to be loud, talkative, active, disruptive members of a class. Throughout the history of schools, students like these have been "labeled" in different ways. Sometimes authorities have simply said they were "bad" children who could only be brought into line by a good beating with the hickory stick. Much more recently, psychologists have claimed that some of these children were emotionally disturbed and needed psychiatric care. Either of these diagnoses might be correct for at least *some* of the school's problem children, of course. But how many is "some"?

For over a century, some scientists have suggested that one major cause of disorderly schoolchildren is something called hyperkinesis (hyperactivity), a disturbance of the central nervous system. Although no one is at all clear about the cause, source, or even the exact nature of hyperkinesis, symptoms seem to be similar to those displayed by many "troublesome" students: nervousness, restlessness, impulsiveness, garrulousness, and, generally, behavior which disrupts orderly discipline at school and in the home. The term minimal brain dysfunction (MBD) has been applied to this general set of conditions. Estimates of the number of children who have MBD ranges from 1% to 20% of later elementary school children, especially boys.

Replacing the hickory stick or psychiatric couch for MBD students is an entirely new form of therapy: drugs. Research has produced the somewhat unusual finding that certain stimulants are especially effective in calming down students who have been diagnosed as MBD cases. That is, a child who is overactive and disruptive in school can be given carefully regulated doses of certain drugs like Ritalin (methylphenidate). The child returns to school a quieter, better disciplined, more manageable child. Since most of the signs of hyperkinesis disappear before or during puberty, there is little or no danger of children becoming addicted to any drug. One authority on this subject has recently estimated that about 10% (100,000 out of 1,000,000) schoolchildren in Los Angeles are now taking Ritalin on a regular basis.

The advantages of this type of drug therapy are both obvious and extensive. From the standpoint of schools, of course, that most diffi-

cult of classroom problems, discipline, is now much more subject to the control of principals and teachers. From the standpoint of parents, there is the advantage of preventing their children from being labeled as "troublemakers" and heading into an educational future with that handicap. From the standpoint of children, there is the possibility of an *external* method (drug therapy) for handling personal behavior over which they have little control themselves. Finally, from the standpoint of pharmaceutical companies, there is the possibility of some profit to be made from the sale of these drugs.

Perhaps the most troublesome aspect of this whole situation, however, is diagnosing MBD children. After all, the symptoms of hyperkinesis are not much different from those of a very nervous child. From a practical standpoint, the question is how you can tell if a child who is disruptive in the class is "ill" or "normal"? That problem has not yet been solved to the full satisfaction of physicians, educators, and laypersons.

Case Study: Controlling the troublemakers at Fillmore

Millard Fillmore Junior High School is located at the outer edges of the inner core of Wildwood City. As in many large cities, Wildwood's downtown area is populated by families with low income, more than half of whom are nonwhite. The nearby suburbs, on the other hand, tend to be made up of middle-class white families. The children of both these groups attend Fillmore Junior High.

Recently, disruptiveness and tension at Fillmore have been running high. There have been a number of "incidents" in which students have attacked other students and teachers. This has accompanied the usual high level of disobedience and misbehavior within many individual classrooms. Some people have tried to blame the high level of tension on racial problems, but in a number of cases, fights have been among members of the same race. Attempts to explain the problem on the basis of class conflict (lower class vs. middle class) have also not been very convincing. Some authorities have complained that pressures in the community as a whole are simply so great that kids are just too "keyed up" most of the time. Whatever the cause, conditions have become so bad at Fillmore that police patrol the school halls while classes are in session, and two school board members have actually called for closing the school a month early this year.

Dr. Arthur Winsome, Professor of Educational Psychology at the nearby state university, has suggested that at least part of the problem at Fillmore could be resolved by the use of drug therapy. His plan calls for each student with a disciplinary record to be screened by a board of three physicians. This board would then recommend drug therapy (either tranquilizers or stimulants) for those it diagnosed as hyperkinetic. The permission of parents would be necessary before therapy actually began, but for those who agreed, the city would pay 75 percent of drug costs and the parents, 25 percent. While this plan might not eliminate Fillmore's problems, Winsome claims, it should help to reduce them significantly.

The Buck Stops Here

As a member of the local school board, would you favor or oppose Dr. Winsome's plan? Support your position with data and/or expert opinion.

Additional Questions

1. Would Dr. Winsome's plan work? Why or why not?
2. Some people might say that students should have a right to say whether they want to participate in this program or not. What would be your reaction to that suggestion?
3. There is some concern that a technique like this in the hands of the wrong people could have serious effects on the citizens of a country. In the Soviet Union, for example, it has recently come to light that one way the government has of taking care of political opponents is to define them as "mentally ill," and then place them in mental hospitals for years. Do you regard drug therapy in schools as that kind of threat? Why or why not? What kind of protection should there be (if any) to protect students from the misuse of drug therapy?
4. Within the past few years there has been a growing movement to protect "student rights." The spokespersons for this movement claim that many of the routine rules and procedures in schools (for example, locker searches for library books) are violations of the civil rights of minor American citizens (i.e., students). What would be your feeling about this issue? Does the practice of drug therapy fall into the category of a violation of student civil rights? Why or why not?
5. Another technique that has been used to patrol student behavior is closed circuit TV. Many schools have had serious problems with drug use, cigarette smoking, and vandalism in "hidden" areas of the school. One solution has been to install TV monitors in these areas. Students can be observed

at all times in this way. What favorable or unfavorable comments can you make about this idea? See what you can learn about court cases involving the actual use of closed circuit TV systems in schools.

6. Although the condition we have called MBD or hyperkinesis was first described in the 1880s, physicians, scientists, and educators still do not seem to be able to agree on a definition of the term, a description of the symptoms which accompany the condition, a possible cause (or causes), or a treatment. How would you interpret all of this uncertainty?

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Topic nine
But would **you** *volunteer? Human experimentation*

Introduction

Should nonscientists have anything to say about the way scientific research is done? Most people would probably say "no" to this question. The scientific method has been remarkably successful for nearly four centuries in figuring out how the universe works. By following a fairly definite set of procedures, scientists have learned to control nature and put it to work for the benefit of humans. But there are times when the methods used by scientists are of concern to laypersons. Research on human beings is such an area.

A basic principle of scientific research is that no theory can be accepted unless it is thoroughly tested by research or by observation. But what if that theory deals with the nature or behavior of human beings? Does the scientist have the obligation—or even the right—to study men and women in the same scientific way he or she would study other "objects" in nature? Suppose, for example, that a psychologist has theorized that children who are whipped three times a day do better in school than those who are not. Does this mean that the psychologist should be allowed to test this theory by selecting a group of children and whipping them three times a day to see how they do in school? If the researcher doesn't have that opportunity, how will he or she ever know whether the theory is correct or not?

Of course this is a rather absurd example, but it's easy to find similar cases which are not at all absurd. The problem of drug-testing is a case in point. It's clear that we can't produce drugs and medicines to treat human disease without first testing them on human subjects. But any research like that always carries with it certain dangers to those being tested.

Almost any human who takes part in experimental research faces some type of risk to health and/or life. What kind of protections, guarantees, or rewards (if any) should be made available to these volunteers? (photo courtesy of New England Nuclear)

What if the substance being tested is toxic or carcinogenic? Is it legitimate to take chances with human lives to test the efficiency of a drug? If so, whom should we solicit and/or select for these experiments?

Historically, scientists have chosen human subjects from four groups for their experiments: prisoners, mental patients, students, and members of the military. The researcher may offer financial rewards to these subjects. Or he or she may appeal to their sense of altruism, emphasizing the good that may come to humans as a result of the experiments. Or, the researcher

may offer other kinds of rewards—better living quarters or a shortened sentence for prisoners, for example—to encourage participation in the research.

For many years, the key restraint on experimentation with humans has been the principle of "informed consent." This means that persons participating in an experiment must (1) understand what the experiment is about, including the possible risks he or she may face and (2) agree as a "free will" decision to take part in the experiment. Under these conditions, it would appear, only those who really do agree to take part in an experiment will be chosen.

The real problem with this concept, however, has to do with the ability to get "informed consent" from some possible subjects. If we want to test a new medication on mental patients, for example, can we really get mentally ill individuals to understand and agree to their participation? Can a prisoner *really* be expected to give his or her "free consent" when there are so many subtle and not-so-subtle pressures for him or her to agree?

Few problems in medical ethics are as difficult as this one. Nearly all institutions in which human experimentation is conducted now have review boards for this kind of research. Any scientist who wants to use human subjects in an experiment must submit an outline of the research to the review board first. If the board determines that no individual's rights are being infringed, the research is approved.

Case Study: Treating antisocial behavior

Dr. Horly Prudence at the state university has developed a new drug which he believes will effectively control violent antisocial behavior in criminals. His experiments with laboratory rats and monkeys has shown that the substance produces a sedative-like effect on both species. Even electrical stimulation of the brain which would normally call forth aggressive behavior in the animals is modified by prior doses of the drug. The laboratory animals have experienced some physical discomfort and occasional loss of ability to perform simple intellectual tasks which they had mastered before the experiments. But no serious, long-term effects have been noticed.

Dr. Prudence is now eager to try his medication on patients at the Sunset View State Prison. His plan is to select thirty volunteer prisoners to serve as subjects who will receive the drug and thirty other volunteer prisoners who will be given a placebo. He expects to be able to determine definitively the effectiveness of the drug from these studies.

In order to encourage prisoners to volunteer, Dr. Prudence has been given approval by the parole board to promise them a reduction in their terms of 20 percent. Someone sentenced to a term of ten years, for example, would have his or her term reduced to eight years.

The Buck Stops Here

You are a member of the review board at the state university and a first-year instructor in the English department. You have been asked to decide on the ethical issues involved in this research. Based on what you have read and know about this case, would you approve or disapprove the study? Explain your decision in detail.

Additional Questions

1. Suppose that it is simply not possible to use human subjects in a particular experiment. For example, we might want to know the effect that very high levels of nuclear radiation have on humans. Actually subjecting volunteers to the levels being studied would probably cause many deaths. What other techniques are available to a scientist for answering a question of this kind? How reliable are the answers obtained by each technique you name?

2. In the case study described here, how could you be sure that every volunteer really gave his or her *informed consent* to take part in the experiment?

3. Is it *ever* possible to get true informed consent from members of each of the following groups?

   a. mentally retarded individuals

   b. prisoners

   c. emotionally disturbed patients

   d. students in elementary school

   e. college students whose teacher is also the researcher

   Tell the circumstances under which informed consent *could* be obtained in each case. If you think it *never* could be, tell why.

4. An extreme example of this problem might be the case in which a person has fallen seriously ill and is in a coma. A doctor believes she can cure the patient with an experimental treatment, but obviously has no way to get the patient's approval. Is there anyone else who

can give this permission? Explain your answer(s).

5. Can you imagine any situation in which a group of individuals no longer *has the right* to decide whether they will participate in an experiment, a situation in which it is permissible (legally and ethically) for someone else to *force* them to take part in an experiment?

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Topic ten
New knowledge and new problems: Defining death

Introduction

The only things we can be sure of in life are death and taxes. And now, it looks as though we may not even be able to count on the first of these as a real "certainty."

Through most of human history, death has been a dramatic and significant event. Detective stories, great novels, and religious accounts all have included references to the dramatic final gasp that seemed to mark the end of a human life. In some cultures, death is seen as the moment at which the spirits leave a person's body. Christians of both earlier and modern times have viewed that same moment as one in which a person's immortal soul departs its earthly home. Whatever the case, there has seldom been much doubt that death was a specific, concrete event that occurred at a very definite moment in time.

Biologists have long known that this view of death is probably oversimplified. A living organism as complex as a human being consists of a network of systems, all mutually interdependent. Three of these are particularly crucial: the brain, the circulatory system and the respiratory system. The combination of the latter two—heart, lungs, and blood vessels—bring oxygen and food from outside the body via the blood to individual cells. When either of these systems breaks down and cells are deprived of their nourishment, they begin to die rapidly. Heart failure, massive hemorrhaging, or inability to breathe, for example, all result in massive cell death—and consequent death of the organism—in minutes or hours. The third part of the system, the brain, is the single organ most dependent on the circulatory and respiratory systems. Failure to provide blood to the brain is the most dangerous of all events. Such failure can produce "death" in the brain (i.e., irreversible brain damage) even though the body itself may survive.

Traditionally, this analysis of the way that bodily parts function more or less separately (but not independently) has generally been of academic interest only. For any person "at death's door," all systems were likely to fail simultaneously, or at least nearly so. Modern medical technology has introduced some new factors in this equation, however. To begin with, synthetic devices are now able to maintain any one of these three systems artificially. The artificial heart, for example, can take over if a patient's own organ is unable to carry on its normal function. A man or woman's heart could, therefore, be essentially "dead" although the patient himself or herself continues to live. Relying on a single "life sign" (natural pulse, for example) at a time like this would be inconclusive.

A second way in which medical technology has compounded the problem of dying is with the development of organ transplants. One element in the potential success in providing a patient with a donor's heart, for example, is the condition of the donor heart. It is crucial to the recipient's chances that the new heart be transplanted as soon as possible after the donor is dead. The exact moment at which death occurs is, then, far more important than it would be if there were no transplantation considerations.

Case Study

In an effort to resolve issues like those raised in the introduction, a bill* has been proposed in the state legislature. Its purpose is to provide a legal definition of "death" in the state. The main provisions of the bill are that death shall have been considered to have occurred:

*A bill with wording similar to this became law in the state of Kansas in 1971.

***Scientists have developed artificial** blood, synthetic skin, and human-made organs, such as this artificial heart. There are few parts of the human body that cannot now be replaced by synthetic products. What problems and issues does this create for deciding when it is that a person is "dead"? Of what significance is the question, "Is that person dead?"* (photo courtesy of the University of Utah)

1. In the absence of spontaneous respiratory and cardiac functions, OR,

2. In the absence of spontaneous brain function. Section 7 of the bill also provides that: "Death is to be pronounced before artificial means of supporting respiratory and circulatory functions are terminated and before any vital organ is removed for the purposes of transplantation."

The Buck Stops Here

As a legislative assistant to the committee on health and safety, to which the bill has been referred, your job is to prepare an analysis of the major issues raised by the bill. You should be able to prepare a list of favorable and a list of unfavorable features of the bill. You will be asked to present this analysis to the members of the committee for their consideration. Your analysis should be unbiased, and reflect no personal opinion of your own on the issue.

Additional Questions

1. Having made your presentation to the committee, you are asked how you personally feel about the bill. What is your response?

2. Do you feel that the definition of death given in this bill is adequate? Why or why not?

3. Does the possibility of organ transplants tend to represent a threat to the life of a seriously ill potential donor? Explain your answer.

4. What criterion (or criteria) do physicians traditionally use to determine death? In what respects would these criteria be inadequate today?

5. One critic of the bill has said that the judgment of two physicians would be a better basis for determining the moment of death than would a legal definition. What is your opinion of this viewpoint?

6. Is there any danger in having the doctor who is to perform an organ transplantation be the same doctor who decides on the moment of death of the potential donor? Why or why not?

7. It is conceivable that a patient might be kept alive even after the failure of all of his or her natural systems. In such a case, what will constitute "death" for that patient? What medical and ethical problems arise from a situation such as this?

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(Also check the *Background Reading List* for Topic I. 1: The Prolongation of Human Life, page 6, for additional, related readings.)

Topic eleven Eating poorly in an affluent society: Nutrition in the United States

Introduction

Poor nutrition in America? On the surface, this would seem highly unlikely. Most of us are aware of the "high standard of living" that exists here. Statistics abound to show that the United States in the 1980s is one of the richest and best-fed nations in the world. We are constantly reminded—especially when food prices go up—that Americans spend a smaller fraction of their income on food than any other people in the world, now or ever in history. Twentieth-century America represents one of the few examples in history of a nation whose people do not spend all or a vast majority of their working hours just getting enough food to stay alive. How many other countries have been able to produce so much food that they could sell, give away, store, and even burn up their excess supplies without damaging their own ability to feed their people? Yes, improving our food supplies and nutritional patterns would seem to be a modern-day example of "carrying coals to Newcastle."

But to any American conscious of our country's eating habits, there's far more to the story than contained in the preceding paragraph. There continues to be the fact, for example, that for millions of Americans, hunger *is* a problem. Migrant workers in California, black families in Bedford-Stuyvesant, and unemployed farmers in Appalachia all face nutritional problems not much different from the hungry and undernourished in India, Botswana, Costa Rica, or any other less-industrialized nation. Surpluses of wheat, corn, and other foodstuffs about which we boast and which we gladly send to the foreign poor play virtually no role at all in correcting the nutritional deficiencies of our own poor.

Scientists are just now beginning to realize the full effect of poor or inadequate diets on a person. We've probably always believed that it was only right that everyone have enough to eat for humane reasons, if nothing else. Now it seems likely that not having enough to eat is the first step in a whole host of medical problems. And although the numbers of people who die throughout the world from starvation directly is large enough, the additional millions who die from diseases arising out of nutritional deficiencies is even more awesome.

Hookworm, ascariasis, trachoma, endemic goiter, and dozens of other diseases claim millions of lives annually throughout the world. They could probably all be vastly reduced if people had enough food to develop the bodily resistance to fight off those diseases. Mental retardation and high rates of infant death are also both traceable to malnutrition. They too could probably be brought under control in this country with adequate distribution of our already adequate food supply. In a recent congressional hearing on nutrition problems, an expert in the field claimed that almost half of our nation's annual $75 billion medical expenses could be traced to problems of inadequate eating habits. Proper nutrition could, some believe, reduce heart and vascular diseases by 25 percent and arthritis, diabetes, and infant mortality by as much as 50 percent!

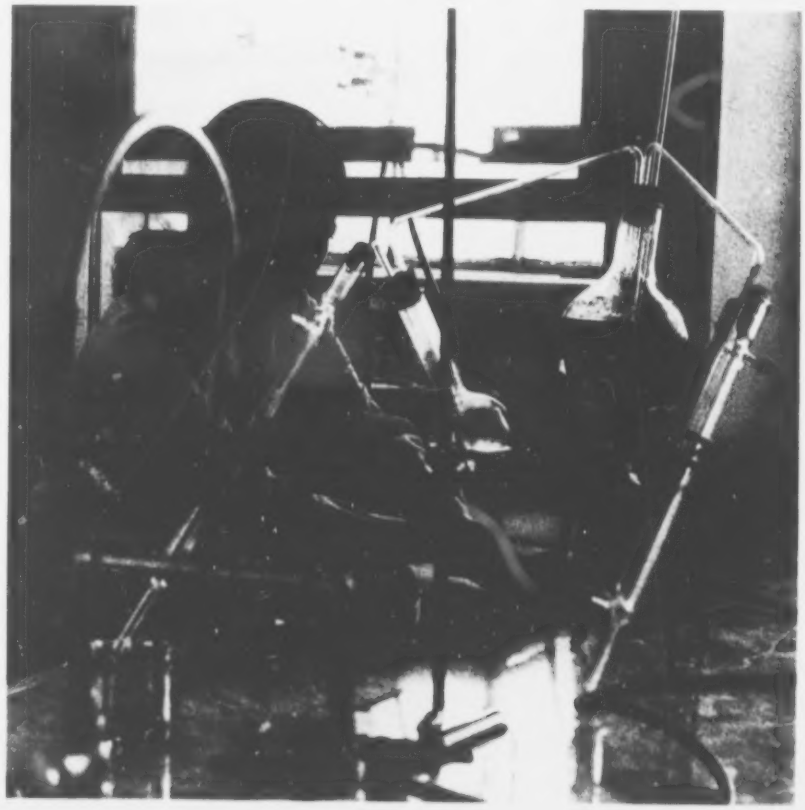
The first case study below deals with the problem of simply making sure that every American citizen gets enough food to maintain a healthful diet.

For the great majority of Americans, however, the issue is *not* being unable to get *enough* food. It is not eating the *proper kinds* of food. For a nation as prosperous as the United States, it seems strange to talk about poor nutrition. But, in fact, nutritional studies over the past two decades consistently show that far too many Americans maintain diets that are "unacceptable" or "deficient" from a nutritional standpoint. And, in most cases, money is not the problem. Less-than-satisfactory nutrition is as likely to be found among the upper and middle classes as it is among the poor. What factors do account, then, for our apparent lack of interest in healthful diets?

One reason may be the fast pace of American life. It's easier and quicker to grab a bag of potato chips and a soft drink on the way to school than to sit down to a carefully planned and prepared breakfast. A nutritious diet is certainly *possible* for those who are constantly on the run. But it doesn't seem to be the most likely thing that will happen.

Some people might argue that Americans have simply developed a taste for foods that happen to be not very nutritional. There's no question that soda drinks, potato chips, sugared cereals, artificial pastries, and a host of other products that taste good but contribute little or nothing to one's health are extremely popular today. Food companies might argue that they produce these junk foods purely to meet the demand of consumers for them.

That argument would be a bit naive, however. One can hardly watch television or read other forms of advertising very long without realizing the intense campaign used to "sell" such foods to the public.



Children are "hooked" on these foods early in life and stay with them until they become adults—all of which is not bad for the food industry ledger sheets. Most junk foods can be produced at rather modest cost and sold at rather extravagant profits. Imagine what it would cost to produce a liter bottle of a soft drink, for example, and then check the price for the bottle next time you're in a supermarket. Poor nutrition may be bad for individuals, but it's not necessarily bad for the food industry. In the second case study, you're asked to think what role the government has, if any, in promoting better nutritional habits among citizens.

Finally, any discussion of nutritional problems in the United States should include some reference to vitamins and minerals. We refer here not to the *solution* of those problems, but to the *compounding* of them! There is no doubt that research on the nutritional value of vitamins and minerals over the past century has shown how crucial these chemicals are for a healthful diet. Countless humans have lived healthier, longer lives because of the knowledge we have about vitamins and minerals. But has this knowledge been put exclusively to good use? Some people might argue that we have become an "over-vitaminized" society. We are so completely sold on the values of vitamins and minerals that we devour them in quantities totally out of proportion to our normal bodily needs. Tens of millions of Americans who eat nutritionally satisfactory diets consume billions of vitamin pills each year. How can this apparent paradox be explained?

There probably are at least three major reasons for Americans' passion for vitamins. In the first place, it's possible that many people still believe in the general axiom that "if one is good for you, two are twice as good." That is, if five milligrams of vitamin "X" are essential for the maintenance of good health, then ten milligrams of "X" will make you *twice* as healthy (whatever that may mean). As you well know, that argument is both biologically and logically wrong. In most cases, the human body uses only the vitamins it needs and sloughs off the rest. The additional vitamin "X" consumed serves no useful function and is probably eliminated unchanged. In fact, in some cases, an excess of a particular vitamin has been shown to be damaging to the body.

In at least two cases, however, one could make an argument for the use of vitamin pills. The first instance might be among those of us (especially teenagers) who do *not* maintain a healthful diet, even though we *could* if we chose to. The argument that anyone *can* eat nutritionally in the United States today is irrelevant if people *don't*. And far too many of us who choose to live on hamburgers, hot dogs, and french fries, or choose to skip breakfast and gobble lunch *don't*. The second instance might include those who, in their quest for slimmer waistlines, select a commercial diet program from which vitamins are lacking. After all, one can be assured adequate intake of vitamins from natural foods only if a sufficient variety of foods is maintained. And diets which rely on a single class of foods may well *not* provide that variety.

So, given the eating patterns of many modern Americans, it is not inconceivable that vitamin supplements *may* be necessary in some cases. The question may well be whether everyone who is now taking them needs them and whether they're taking the kind and amount they really require. It is questions like these that inspire the third case study that follows.

Food corporations spend enormous amounts of money each year developing artificial foods. They then spend even more money advertising these foods and creating a "consumer demand" for them. In what sense is this a wise investment of money? In what sense is it not a wise investment? (photo courtesy of the World Health Organization)

Case Study #1: How to distribute our food supplies

Rep. Wellington Worthy (D, NY) claims to have "had it" with the United States' strange food policies. "How can we justify selling food or giving it away to people in other countries," he asks, "when so many of our own citizens are malnourished? Why should we pay farmers *not* to grow crops when people are hungry? How can we justify price support programs for non-essential crops like tobacco when people are starving in New York City?"

The solution, proposed by Rep. Worthy and embodied in HR 4751, contains the following essential elements:

1. The Department of Health and Human Services (HHS) is to establish a "minimum adequate nutritional level" (MANL) for all American men, women, and children.

2. All "excess" foodstuffs now being sold or given to foreign countries *must* be used first to feed all families that fall below the MANL. Any food remaining after this requirement has been met may then be released for foreign aid programs.

3. All funds now budgeted for artificial price support programs on non-food crops (e.g., tobacco)

are to be transferred to HHS for the improvement of food distribution to families below the MANL.

The Buck Stops Here

Assume the role of the Congressperson who represents your district in the United States House of Representatives. Decide what stand you would take on Rep. Worthy's bill. Prepare a brief statement that you would be able to distribute to your constituents. The statement should outline both the good and bad points of the bill as well as any changes you would make to improve the bill.

Additional Questions

1. The above description contains no arguments opposed to Rep. Worthy's bill. Are there any? What are they?

2. How would you (or anyone else) go about defining a MANL? Does one now exist? If so, what is it?

3. How many people in the United States are now "hungry"? How many are "malnourished"? Are these two terms the same in meaning? Are the numbers of people in both categories the same? Why or why not?

4. If you are opposed to the solution offered by Rep. Worthy, what alternative solutions are there to the problems of the undernourished in this country?

5. See what you can learn about the *specific* biological effects on humans of inadequate diets. What diseases or other health problems can be traced to malnutrition and what is the relationship between the two?

6. In what respects could "hunger" be regarded as a *public health* problem? Should it be so regarded and so dealt with in America? Why or why not?

Case Study #2: Improving nutritional practices

Concerned about the growing influence of low- and non-nutritional foods on the American diet, the American Council on Health has passed the resolution reprinted below. It is the council's intention to find one or more members of the Senate and the House to introduce the resolution in the form of a bill.

A resolution from the American Council on Health:

Because we are disturbed by the increasingly widespread popularity of "junk foods" in the United States, we call upon the Congress of the United States to create a new federal agency, the Office for Better Nutrition (OBN). The function of the Office will be to disseminate information, by the most effective means it can develop, about sound nutritional practices.

This might include the development of curricula for the schools, the production of articles for newspapers and magazines, and the creation of a massive television advertising campaign similar to those now conducted by the manufacturers of soda drinks and candy bars, for example.

Funding for the OBN would come from two sources. First, each food corporation would be assessed ten percent of the total amount of money it currently spends on advertising all low- and non-nutritional foods it produces. Second, a five percent tax would be assessed on each bottle, can, box, or container of low- and non-nutritional food sold. The definition of low- or non-nutritional food would be developed by a group of nutrition experts, but would reflect foods that are very low in proteins, vitamins, and minerals.

The Buck Stops Here

You have the opportunity to look at the resolution and decide how you feel about it. Your first reaction is that it is a strongly worded statement that presents only one side of the case. You realize that a bill based on this resolution has little chance of passing since it does not take into consideration the possible counterarguments. Your task, then, is two-fold:

1. Write a series of statements that defends the current widespread use of low- and non-nutritional foods in the country.

2. Then make any changes that may be necessary in the council's resolution that will make it more likely to pass in the United States Congress.

Additional Questions

1. The term "junk food" is in popular use today. What does the term mean to you? Name some products you would think of as junk foods.

2. "Food corporations are doing nothing more than responding to the demand of consumers when they produce and sell so-called 'junk foods.' Therefore, the government has no obligation to interfere in this process. Consumers should have the chance to buy and eat what they

want." How do you feel about this argument?

3. Suppose you wanted to convince teenagers that they should eat more healthful diets. You have $1 million to spend on this effort. What specific suggestions do you have?

4. Some people argue that the way to improve our diet is to include a greater proportion of "natural" or "organic" foods. Do these terms mean the same thing? Write a definition for each one or (if they are the same) both. Make a list of some typical "natural" and/or "organic" foods.

5. What reasons do people give for believing that "natural" or "organic" foods are better for your health? Find out as best you can whether these reasons are valid or not.

6. "Natural" and "organic" foods are normally more expensive than processed foods you see in the supermarket. Why would this be so? Are the "natural" and "organic" foods worth the additional cost? Why or why not?

7. Another health problem which is of concern to nutrition experts is that of "fad diets." These are programs—sometimes prepared by experts, sometimes not—designed to help people lose weight. Locate and find out as much as you can about any one of these commercial diets. What kinds of food are and are not permitted in the diet? What are the biological and nutritional principles behind the plan? Are these principles soundly applied? What reasons would you have for recommending or not recommending the diet to someone trying to lose weight?

8. What kinds of nutritional or other health problems may arise by following improper diet plans? You could answer this question in *general* and then with respect to the diet plan you chose to study for Question 7 above.

Case Study #3: Restricting the unnecessary use of vitamins

Congresswoman Guda Hallth has introduced a bill into the House of Representatives making it legal to sell vitamins and minerals by prescription only. Her argument follows the position outlined in the introduction to this topic, namely that the unnecessary consumption of vitamins is becoming a major national health problem. While some people certainly do need vitamin and mineral supplements, these medicines are vastly overindulged by the general population, she believes.

"Physicians can best decide," she says, "exactly which individuals need vitamins and in what quantities. It is foolish that so many millions of Americans waste their hard-earned cash on pills they almost certainly do not need. The only people who can object to this proposal," she claims, "are those drug manufacturers who make phenomenal profits on the sale of unneeded vitamins and minerals."

The Buck Stops Here

As a member of the board of directors of the American Red Cross, you have been invited to testify before the congressional committee holding hearings on this bill. You realize in advance that Rep. Hallth's bill is strongly one-sided. Your first job is to learn what the other side of the story is. Then you will have to decide how you feel about the bill and prepare a statement to present before the committee that will justify your position.

Additional Questions

1. How accurate is Rep. Hallth's implied charge that vitamin pills are an unwarranted profit-making item of the drug companies? (The question of profit-making among drug manufacturers is a complex one. See what has been learned in the most recent studies of this issue.)

2. See if you can mention some specific cases in which an individual might require vitamin and mineral supplements in his or her diet. For example, what vitamin supplements might someone need if he or she were on a popular "fad" diet?

3. What additional problems might arise (nutritionally, socially, economically, etc.) if vitamins were available only by prescription?

4. What are some of the results of consuming an excess of vitamin A? Vitamin D? Other vitamins or minerals?

5. In recent years, some ambitious claims have been made for the efficacy of certain specific vitamins. Some authorities, for example, recommend large doses of vitamin C for the prevention and/or cure of diseases ranging from cancer to the common cold. See what you can learn about claims like this for vitamins C, E, and any other vitamin. Then decide how it

would be possible for a layperson like yourself to evaluate these claims.

6. A woman on a low-carbohydrate, low-fat, high-protein diet, supplemented with an adequate supply of vitamins and minerals may still develop serious nutritional diseases. Explain how and describe what should be done to avoid this possibility.

Background Reading List

"America's Changing Diet." *FDA Consumer*, October 1985, pp. 4-25. *An extensive review of the way our eating habits are changing . . . and what these changes mean.*

Benowicz, Robert J. "The Age of Vitamins." *Family Health*, September 1980, pp. 28-31+. *Latest scientific information on vitamins.*

Brown, Ellen. "A Boycott Works—It Better." *The Humanist*, January 1980, pp. 50-51. *Action by the World Health Organization on the "Nestlé" problem.*

Brown, Michael H. "Fast Foods Are Hazardous to Your Health." *Science Digest*, April 1986, pp. 31-36+. *An exhaustive study of the nutritional value of foods sold at McDonald's, Burger King, and other popular fast food establishments.*

Dalmheyn. "The Nutrition Free-for-All." *Family Health*, January 1981, pp. 25-27+. *Basic information on a variety of contemporary issues in nutrition.*

Dubos, René. "Nutritional Ambiguities." *Natural History*, July 1980, pp. 14-21. *Some interesting anecdotes about what we do and do not know about human nutrition.*

"Feed, Need, Greed." *A teaching unit prepared by the Science Teaching Group of the Scientists and Engineers for Social and Political Action (SESPA), explaining the way social, political, and economic factors influence the diet Americans eat.*

Garson, Barbara. "The Bottle Baby Scandal." *Mother Jones*, December 1977, pp. 32-40+. *An "exposé" article that opened an international controversy that has been raging for nearly half a decade.*

Jacobson, Michael. "The Food Fortification Fraud." *The Progressive*, July 1979, pp. 44-47. *So what's the* harm *in adding vitamins to processed foods?*

Kennedy, Joseph C. "World Hunger." *Vital Speeches*, September 15, 1981, pp. 717-720. *Remarks by the director of international development of Africare, Inc., before the United States House of Representatives Committee on World Hunger.*

Margulies, Leah. "Exporting Infant Malnutrition." *Science for the People*, July-August 1977, pp. 9-12. *Are food corporations creating health problems when they try to sell infant formulas in less industrialized nations?*

Marshall, Eliot. "Diet Advice, with a Grain of Salt and a Large Helping of Pepper." *Science*, February 17, 1986, pp. 537-539. *Nutritionists are locked in an intense debate over the perils of fat and the benefits of vegetable fiber in the human diet."*

Mayer, Jean. "Megavitamin Madness." *Family Health*, February 1980, pp. 48-49. *"How much [of a vitamin diet] is too much?"*

_____ "Of Pizzas, Pretzels, and Turkey Pot Pies." *Family Health*, October 1979, pp. 12-13. *A nutrition expert tells how we can evaluate the "500 new products . . . introduced every year."*

Nickel, Herman. "The Corporation Haters." *Fortune*, June 16, 1980, pp. 126-136. *The business viewpoint on the Nestlé boycott.*

"Nutrition as Therapy." *Consumer Reports*, January 1980, pp. 21-24. *Fact and fantasy about the "proper way to eat."*

Peerman, Dean. "The Conscience of Linda Kelsey." *Christian Century*, March 5, 1980, pp. 244-245. *A Hollywood actress looks into the Nestlé controversy and takes a stand.*

"Sense and Nonsense about Vitamins." *Changing Times*, March 1980, pp. 53-56. *Basic information about what vitamins can and cannot do.*

Serrin, William. "Let Them Eat Junk: The Triumph of Food Processing." *Saturday Review*, January 2, 1980, pp. 17-23. *How the food processing industry has changed our eating habits.*

"The Vitamin Pushers." *Consumer Reports*, March 1986, pp. 170-175. *How valid are the arguments used by retailers of vitamins?*

Winick, Myron. "Nutrition and Brain Development." *Natural History*, December 1980, pp. 6-13.

A review of the evidence on nutritional effects on brain development.

Winikoff, Beverly. "Nutrition, Population and Health: Some Implications for Policy." *Science*, May 26, 1978, pp. 895–902. *A very technical, but valuable, article outlining the way public policy is and can be influenced by biological and behavioral aspects of food and population issues.*

Zwerdling, Daniel. "The Food Monsters." *The Progressive*, March 1980, pp. 16–27. *How the corporate nature of the food industry affects our eating habits.*

Topic twelve
It's none of your business! Cigarette smoking

Introduction

Caveat emptor! The translation of that Latin phrase is, "Let the buyer beware!" The origin of the phrase tells us how the Romans viewed a consumer's responsibility. A person was supposed to be very cautious about anything that he or she purchased. Sellers trying to unload faulty or dishonest merchandise were within their rights. If a buyer were cheated, that was his or her fault.

That philosophy has guided commerce in Western civilization through most of history. Then, about fifty years ago, that practice began to change. Governmental agencies became more active in monitoring the sales of products and services. The passage of the Pure Food and

How many cigarettes a day does your child smoke?
When a child breathes air filled with cigarette smoke
it can be as bad as if he actually smoked the cigarette himself.
Don't smoke when there are children present.

What message do you get from this advertisement? Is it a "good" ad? Is it fair and unbiased? (photo courtesy of the World Health Organization)

Drug law in 1906 was a landmark piece of legislation. It declared that the federal government had an obligation and a right to protect the interests of consumers in the marketplace.

Acts like the Pure Food and Drug law reflect more than simply a changing social philosophy. They were motivated also by some new realities in the science and technology of product manufacture and distribution. In order to exercise the old rule of *caveat emptor*, a citizen of Rome, of sixteenth century Paris, nineteenth century London, or early twentieth century New York didn't have to be an expert in many areas. He or she had to be able to recognize a lame horse, moldy grain, or faulty yarn.

But since the end of World War II, manufacturers have been turning out a staggering variety and number of new products. Many of them are totally unfamiliar to even the most sophisticated consumer. Would *you* buy a gasoline that contains tricresyl phosphate, a lemon pie preserved with butylated hydroxyanisole, or a nondairy coffee whitener that includes p-dichlorodiphenyl-trichloroethane as an ingredient?*

In response to this problem, federal, state, and local governments have become more and more active in reviewing, licensing, and restricting products that are made available for public consumption. Governmental regulations have been extended also to services. Professionals who cut our hair, dispense our medicines, offer legal advice, fly our airplanes, and offer a variety of other services must all pass examinations and often satisfy federal and/or state regulations for ongoing education in their fields.

Have we reached the point where government is *too* involved in the exchange of goods and services? Some people think so. Certainly, there seem to be few areas left in which some governmental agency doesn't try to protect the citizen. Both consumers and manufacturers are tempted to throw up their hands in despair at even understanding what can and cannot be done, what is and is not "OK" in the marketplace. One element in the election of Ronald Reagan as president in 1980 may well have been a public backlash against overregulation by government. Perhaps it's time, some citizens are saying, that we depend more on *caveat emptor*, and less on "The surgeon-general has determined that . . ."

That view is hardly unanimous, of course. The same factors that created the need for governmental regulation in the first place—corporate carelessness and, in some cases, greed—still exist. If anything, science and technology continue to make available even more new additives, new substances, new products about which the public needs to be informed. The government still has the right and obligation to protect the health, safety, and well-being of its citizens, some critics argue.

There is probably no area in which the issue of government regulation has caused as much controversy recently as smoking laws. The facts are fairly simple. 1) Smoking has now been implicated in a number of health problems. It probably accounts for more than half of the cases of lung cancer that develop in this nation. 2) The health of nonsmokers is measurably and negatively affected simply by their sharing the same physical space with smokers. There is probably considerable agreement also on two general principles concerning smoking:

1. Smokers have the right to smoke if they want to, and
2. Nonsmokers have the right to clean air, if they want it.

The obvious problem is that both worthy principles can't be applied at the same time and in the same place. Debates over smoking laws often evolve, then, into arguments as to which right is to take precedence over the other. The case study illustrates one such controversy.

In the fall of 1980, the referendum that follows was presented to the voters of California for their consideration. Following the referendum (in abstracted form) are statements for and against the proposal.

*Your answers should be: yes, yes, no.

Smoking and No-Smoking Sections— Initiative Statute

Official Title and Summary Prepared by the Attorney General

SMOKING AND NO-SMOKING SECTIONS. INITIATIVE STATUTE. Provides for designation of smoking and no-smoking sections in every enclosed public place, enclosed place of employment, enclosed educational facility, enclosed health facility, and enclosed clinic. Does not limit smoking in outdoor areas or private residences. Establishes criteria for defining smoking and no-smoking sections. Requires signs be posted designating no-smoking areas. Violation is infraction punishable by $15 fine per violation. Provides no person may be taken into custody or subject to search for violation. Allows enactment of further legislation and regulations relating to smoking. Requires implementation standards be adopted by Department of Health Services. Fiscal impact on state and local governments: Issuance of regulations by state, posting of nonsmoking signs by state and local governments, and enforcement of measure by state and local governments would result in minor costs to state and local governments. Indeterminable reduction in state and local tax revenues could result from reduced cigarette consumption. Indeterminable savings could result from decline in smoking-related illness among employees and participants in state health-related programs and from decline in fire losses.

Analysis by the Legislative Analyst

Background:

Existing state law restricts smoking of tobacco in *publicly* owned buildings and retail food stores. As a result:

1. Signs must be posted that smoking is prohibited within an area of a publicly owned building (other than in lobbies) when the area is used to exhibit motion pictures, present stage dramas, music recitals, and certain other types of performances.
2. When a public meeting is held in a government building, at least 50 percent of the meeting space must be designated and posted as a no-smoking area.
3. At least 20 percent of the dining area within publicly owned health facilities and clinics and within publicly owned buildings must be designated and posted as a no-smoking area.
4. Smoking is prohibited in retail food stores during business hours, except for areas set aside for smoking by employees only.

Under a state law which will take effect January 1, 1981, smoking will also be prohibited and signs required in certain areas of *privately* owned health facilities and clinics.

Some California cities and counties have local ordinances which prohibit smoking in other private buildings, such as retail stores, in portions of movie theaters, and in portions of restaurants.

Proposal:

This measure would extend the requirement for designation and posting of smoking and no-smoking sections or areas to additional enclosed buildings and facilities, both publicly and privately owned. The types of enclosed buildings and facilities affected by the measure include public places, such as restaurants and retail stores, places of employment, educational facilities, health

facilities and clinics. The measure would not limit smoking in outdoor areas or in private residences.

The measure would require the State Department of Health Services to adopt, by February 2, 1982, specific regulations covering the designation of smoking and no-smoking sections or areas. These regulations will become effective when the remainder of the measure becomes effective on March 4, 1981. The regulations would, among other things, specify the types of facilities and areas which *may* be designated in their entirety as smoking areas, or which *must* be designated in their entirety as no-smoking areas. These regulations would have to be consistent with the following general criteria:

1. Smoking and no-smoking sections need not be separated by walls or partitions.
2. Areas in which it would be inappropriate to limit smoking, such as motel rooms, or rooms normally occupied exclusively by persons who smoke, may be designated in their entirety as smoking areas.
3. Areas in which it would be impractical to designate smoking and no-smoking sections, such as public areas of retail stores, elevators, and buses, shall be designated in their entirety as no-smoking areas.
4. Employees in enclosed places who request work stations in no-smoking areas shall be accommodated.

This measure would not prevent the owner or manager of any facility or area to designate the facility or area in its entirety as a no-smoking area. This measure specifies that the State Department of Health Services shall use existing resources to fulfill its requirements under the measure, and shall not request or obtain additional funding for this purpose.

The measure would also require the owner or lessee of buildings or facilities to post conspicuous signs identifying smoking or no-smoking areas. At *private* facilities, *no-smoking* signs would be required in no-smoking areas. Smoking would be permitted in all other areas. At *government* facilities, *smoking-permitted* signs would be required in designated *smoking areas;* and additional signs, stating that smoking is prohibited except in designated smoking areas, would be required indoors at every facility entrance.

Argument in Favor of Proposition 10

The medical evidence is in!

The health of nonsmokers is harmed by other people smoking in their presence.

WHAT CAN YOU DO ABOUT IT?

Your "yes" votes on Proposition 10 will make sure that smokers have areas in buildings where smoking is allowed where they can smoke without interfering with the health or comfort of nonsmokers.

WHO WILL BENEFIT FROM PROPOSITION 10?

Nonsmokers will benefit. They will not have to involuntarily breathe smoke from other people's tobacco.

People who are trying to quit smoking will benefit. They will be able to separate themselves from the temptations of smokers and smoke in the air.

Young children will benefit by not being exposed to the social lure of smoking as often and by not having to breathe other people's smoke.

Smokers will benefit by being able to enjoy their habit without enduring the scowls of nonsmokers.

HOW MUCH WILL ALL THIS COST?

According to independent studies by University of California professors, government would save $49 million a year and private businesses would save $129 million a year in medical costs of smoking-induced illness to employees, property loss from smoking-caused fires, and extra sick leave used by smoking employees.

HOW WILL PROPOSITION 10 WORK?

In public places smoking would be permitted in designated areas, and nonsmokers could simply stay away from those areas.

In offices and on the job, employees could simply request that there be a reasonable distance between themselves and other employees who smoke.

Nonsmoking workers who don't care either way could be located between the two groups as a buffer zone.

Restaurants and other similar places would have to provide nonsmoking areas for those who want them.

WILL THIS MEAN COSTLY DIVIDERS AND SIGNS?

Not at all. Proposition 10 does not require any walls or room dividers—just a reasonable distance between smokers and nonsmokers.

Proposition 10 also says government agencies need post signs only at building entrances, can spend no more than 50 cents per sign, and must pay for signs out of current revenues with no new taxes.

WHY IS PROPOSITION 10 NEEDED?

Many nonsmokers are annoyed by other people's smoke. Some nonsmokers with heart or lung ailments have their conditions worsened by other people's smoke. Healthy nonsmokers can develop lung ailments from breathing other people's smoke.

The decision to smoke is a smoker's own business and a matter of personal choice. But smokers don't want to harm or annoy others. Proposition 10 will provide areas where smokers can exercise their right to smoke, while allowing nonsmokers the right to remain separated from those smoking areas.

WHO SPONSORS PROPOSITION 10?

The Cancer Society, the Lung Association, the Heart Association, the California Medical Association, and many other individuals and organizations have reviewed the health hazards to nonsmokers from breathing other people's smoke and have endorsed a "yes" vote on Proposition 10.

☐ Raymond L. Weisberg, M.D.
President, American Cancer Society, California Division

☐ Diane E. Watson
State Senator, 30th District
Vice Chair, Senate Health Committee

☐ Peter E. Pool, M.D.
President, American Heart Association of California

Rebuttal to Argument In Favor of Proposition 10

Read the fine print, then vote "No" on Proposition 10.

This proposal is loaded with *hidden taxpayer costs and unfair and misleading requirements.*

The State Legislative Analyst estimates beginning taxpayer costs for printing signs and issuing regulations will be $180,000.

It is difficult to estimate the actual costs to install signs or to enforce Proposition 10. Using an estimate of 260,000 signs, if we assume an installation cost of from $3 to $10 each, *$750,000 to $2.5 million* could be diverted from other governmental programs. And, to the extent that the cost of issuing

and processing citations exceeds the $15 fine, the taxpayers must carry the burden.

Our police and courts should use our tax money to catch and prosecute real criminals instead.

Proposition 10 is a vague law which *allows political appointees and State Health Department bureaucrats to "fill in" specific regulations later . . . with no reviews by the voters.*

Proposition 10 is a misleading and costly overkill approach to a minor social annoyance.

Please vote "No" on Proposition 10.

- ☐ Houston I. Flournoy
  Former State Controller
- ☐ Peter J. Pitchess
  Sheriff, County of Los Angeles
- ☐ David Bergland
  President, Californians Against Regulatory Excess

Arguments printed on this page are the opinions of the authors and have not been checked for accuracy by any official agency.

The Buck Stops Here

As a voter in California in the fall of 1980, would you have cast your ballot for or against this proposal? Explain your decision.

Additional Questions

1. Are you a smoker? How does your status as a smoker or nonsmoker affect your position on this issue?
2. Are there changes that could be made in this proposal that would make it more acceptable to you and, perhaps, to others? If so, what are they?
3. What examples can you mention that shows how government *overregulates* our lives? What examples show that regulation is inadequate?
4. What are the specific health problems that can be attributed to cigarette smoking? How, if at all, are these problems different for nonsmokers who are exposed to cigarette smoke?
5. In a sense, the federal government already tries to influence your smoking habits since it provides large supports to the tobacco-growing industry. Do these supports suggest the government thinks it is OK for people to smoke, and encourages them to do so? How, if at all, is this different from actually passing laws?
6. The law prohibits the smoking of marijuana, but not tobacco. Why does this difference exist?

Background Reading List

Blair, Gwenda. "Why Dick Can't Stop Smoking." *Mother Jones*, January 1979, pp. 30-40. *Corporate influences on public attitudes toward smoking.*

Clark, Matt, and Dan Shapiro. "Secondhand Smoke and Lung Cancer." *Newsweek*, January 26, 1981, p. 63. *A brief article reporting some research on this topic and possible political action that may arise from it.*

Dillow, Gordan L. "Thank You for Not Smoking." *American Heritage*, February 1981, pp. 94-107. *A fascinating historical account of the war against cigarette smoking.*

"Does Smoking Harm the Nonsmoker?" *World Health*, May 1985, pp. 30-31. *A review of current evidence.*

"Grim Reckoning." *Scientific American*, May 1985, pp. 82-84. *An attempt to estimate the number of deaths caused by smoking each year.*

Mark, E.R. "Can Your Husband's Cigarette Give You Cancer?" *Good Housekeeping*, May 1981, pp. 255-256.

"The Morality of Smoking." *America*, January 27, 1979, pp. 44-45. *Why smoking is a moral issue now.*

Repace, James L., and Alfred H. Lowrey. "Indoor Air Pollution, Tobacco Smoke, and Public Health." *Science*, May 2, 1980, pp. 464–472. *A highly technical research report which should be read for its overall conclusions rather than its details.*

"Smoking: Dangerous to your Spouse?" *Science News*, January 24, 1981, p. 53.

"Two More Bricks in the Wall." *Science News*, May 18, 1985, p. 312. *Latest information on the health effects of "second-hand" smoke.*

Brief commentaries on the California vote described in the case study above appeared in a number of magazines close to election time. See, for example, *Newsweek*, October 2, 1978, pp. 56–59; *Business* Week, September 11, 1978, p. 53, and *Christian Century*, October 4, 1978, p. 911.

Conflicting research evidence on the health effects of smoking for nonsmokers began to appear in the late 1970s. See, for example, *Newsweek*, April 7, 1980, p. 77; January 26, 1981, p. 63; *Time*, April 7, 1980, p. 71; July 6, 1981, p. 43; *Good Housekeeping*, April 1979, p. 262; *Maclean's*, January 21, 1980, p. 40, and *Science News*, July 4, 1981, p. 6.

Topic thirteen The hazards of everyday life: Environmental health

Introduction

"Life causes cancer." That bumper sticker has recently been seen in many parts of the country. It has been inspired by news reports about the many potential health hazards in our environment. At one time or another in recent years, studies have shown that such familiar parts of our surroundings as cigarettes, coffee, sugar, saccharin, power lines, microwave ovens, and even drinking water (!) may be dangerous to our health.

Why this sudden rush of concern about possible health hazards in our environment? Our parents and grandparents probably never gave a thought to the harm in a second cup of coffee or the dangers of living near a high voltage electrical line. At least three reasons might be mentioned for our new concern about health hazards in the environment. First is the increased confidence that humans have about their ability, in general, to make their lives safer and healthier. A century of improved medical, surgical, and public health practices has shown us that we do not have to be fatalistic about the "ills that beset humankind." We do have a good deal of control over disease, accidents, illness, and even death. We no longer have to plead with spirits or perform magical rituals to avoid cancer: We can stop smoking, if we want badly enough to stay healthy!

Secondly, the methods that are now available for detecting health hazards are increasingly sophisticated, sensitive, and accurate. Scientists can measure substances at the concentration of one part in a billion or one part in a trillion. And they can determine at least some of the health effects of a chemical in very low concentration on laboratory animals.

Research has helped us to see that substances we thought were perfectly safe may have long-term

carcinogenic, teratogenic ("monstrosity-producing"), or genetic effects. And we've learned that other substances we may not have realized were even present do exist at very low concentrations and can have health effects.

Thirdly, the amount and variety of new materials finding their way into our environment is becoming greater every year. Think of the incredible number of synthetic products with which you come into contact every day: medicines, fabrics, plastics, food additives, fuels, dyes, beauty products . . . the list goes on and on. A great majority of these are artificial, human-made products that do not exist in nature. Many of the products themselves, and the raw materials from which they are made, can be harmful to human health. As scientists become more and more proficient at inventing and producing new materials, problems of environmental health are likely to continue to increase.

The impact of these changes can be seen all around us. For one thing, the government has become much more active in monitoring environmental hazards in an attempt to protect citizens from the increased risks around us. At the federal level, agencies such as the Occupational Safety and Health Administration (OSHA), the Environmental Protection Agency (EPA), and the Food and Drug Administration (FDA) administer laws passed by the Congress, develop rules and regulations, and monitor and enforce these laws and regulations. Many state and some local governments have protection agencies similar to these. Whole new careers that did not exist thirty years ago have come into being in response to this trend. Environmental health scientists, for example, are now in demand by government and industry. Their job is to see that private businesses and individuals abide by rules designed to protect citizens from environmental hazards.

The movement to protect us from environmental risks has run into two roadblocks. The first is public apathy about these risks. This attitude is reflected in the bumper sticker quoted at the beginning of this topic. *Everything* causes cancer, or so it seems to many people. Hardly a day goes by without some new report of some new danger from a familiar substance. Why not just quit worrying and enjoy life? Besides, in most cases, everything we know or suspect comes from studies of laboratory animals. Why should we get excited about what happens to a mouse; humans are different.

In fact, this attitude is incorrect and is potentially dangerous. As pervasive as dangerous substances seem to be in the environment, they do not include everything we know of. In fact, of the thousands and thousands of chemicals that have been tested, only a very small fraction of them represent any kind of risk in our lives. The rest—mostly natural products—appear to be perfectly safe to human health. And while it is true that laboratory animals are *not* humans, the information we can get from such studies is very reliable and useful.

The second problem concerns the possibility of overregulation on the part of government agencies. There is a growing concern that OSHA, FDA, EPA, and other protection agencies are interfering too much in the lives of individuals and

Some industrial companies have strong health and safety programs of their own. They carefully monitor the condition of their employees' health without being forced to do so by federal or state regulations. What reasons would a corporation have for offering a vigorous health and safety program like this? Would some aspects of an employee's health be of greater concern than others? Why or why not? In what respects and for what reasons might a company NOT be interested in the health and safety of its employees?

the operation of business and industry. As one reads some of the very detailed requirements published by these agencies, it's easy to see how this attitude has developed. In some cases, the steps needed to abide by government regulations designed to protect consumers are so involved that it may no longer be profitable even to market the product. Business and industry are strenuously fighting back against the excesses of overregulation.

Granted these objections, there is some cause for concern as to where this backlash will lead. It is important to recognize that conforming to health and safety regulations is an expensive consideration for any business. The more we become concerned about consumer protection, the more expensive it will be. What is the correct limit to which the government should be involved in this process? Are warning labels adequate? Does the government need to test products before they are released? Is industry responsible for self-regulation of any kind? How can we tell when either industry or government has gone "too far" in causing or preventing risks?

These are questions for which there are no good answers at the moment. It seems possible that efforts to protect citizens from environmental hazards went too far in some areas in the 1970s. In other areas, they may not have gone far enough. The 1980s have seen the pendulum swing back in the other direction. Again, useful regulation has been withdrawn in some areas, but helpful new rules have been adopted in others. Are there any general principles on which regulation can be based in the future? How can we insure that companies can make a fair profit while still being sure that consumers are not exposed to unnecessary and dangerous risks in the environment?

The *Background Reading List* reviews a variety of problems of environmental health. Included among these are issues such as industrial chemicals in the environment (PCBs and Kepone), hazardous chemical wastes (also see *Background Reading List*, page 116), heavy metal poisoning, hazards in the workplace (e.g., asbestosis), and dangers from electromagnetic radiation.

Of the two case studies for this topic, the first is unusual. Instead of having a specific situation to react to, you are asked to develop a case study of your own. From the problems described in the *Background Reading List*, choose one that especially interests you. Then write your own case study for this topic. The second case study deals with another aspect of environmental health issues: the practice of "dumping" banned products overseas.

Case Study #1: Writing a case study

Examine the *Background Reading List* below for a topic that may be of special interest to you. Then, working on the model of other examples in this book, write a case study and *The Buck Stops Here* for this topic. You may either invent a case of your own, or adapt one from real life. Prepare a set of at least six *Additional Questions* that draw attention to major aspects of your case. Finally, prepare an expanded reading list (at least eight articles) for your topic.

Case Study #2: Tris

The story of "Tris" illustrates the dilemma faced by many chemical industries today. "Tris" is the trade name for tris (2, 3-dibromopropyl) phosphate, a chemical used to reduce the flammability of cloth. Until recently it was widely used in the manufacture of children's sleepwear. The flame-retardant properties of Tris permitted manufacturers to produce clothing that met federal safety standards.

About 1975, however, some troubling research studies began to appear. Experimental animals exposed to Tris developed cancer and produced defective offspring significantly more often than did a group of control animals. By 1977, the Consumer Produce Safety Commission concluded that Tris *did* represent a carcinogenic and mutagenic threat to humans and directed all manufacturers to remove Tris-treated clothing from the market.

The children's sleepwear industry recognized the dangers of Tris and—reluctantly—removed its products from store shelves. The problem it faced, of course, was what to do with millions of dollars of unsold pajamas, nightgowns, and sleepers. One solution soon emerged: ship the products overseas and market them in countries where Tris was not banned.

The solution was not a novel idea. Many times in the past, American businesses have marketed products overseas which had been banned at home. It seems like an ideal way out of a financially difficult situation: Manufacturers do not lose money on their work, and American consumers are protected from potential health and safety risks. Consumers in other nations may be less concerned about environmental hazards than Americans are and often are perfectly willing to purchase these products. The following case involves some of the common elements of this problem faced by industry:

You are a stockholder in the Beddie-Bye Sleepwear Company of Arlington, Virginia. Attending the company's annual meeting, you first

hear the details of the "Tris-problem" facing the company. Cognizant of the necessity for flame protection in its products the company began using Tris on all its products, even before federal regulations required the use of flame retardants. The government's action has now caught the company with its sleepers down! Over $5 million worth of products had to be recalled from retailers. Unless the company finds a way to sell these products, it may go bankrupt. The board of directors sees one way out of the problem. It could merchandise the recalled sleepwear at retail outlets in Great Britain, Poland, Austria, South Africa, and Japan, where it already has contacts. In none of these cases is there a prohibition on the sale of these products.

The Buck Stops Here

Stockholders will have the opportunity to speak about and then vote on the board of directors' suggestion. How would you vote? Explain your decision.

Additional Questions

1. What arguments could you give both *for* and *against* the practice of "overseas dumping?" Answer this question from the standpoint of (a) an officer of the manufacturer involved, (b) a private citizen of the United States or Canada, (c) the Minister of Economics of Poland, and (d) a private citizen of Poland.

2. What responsibilities (if any) does the United States government have toward a business whose product has been banned from sale?

3. "The job of the government is simply to *notify* consumers of possible risks, not to force products off the market. Consumers should have the right to *choose* whether or not to purchase a potentially harmful product." Comment on this proposition.

4. "There are so many potential hazards in the environment, it's better just to ignore them. If a person worried about every chemical that gave rats cancer, he or she would never eat, wear, or buy anything!" Comment on this argument.

5. Are there *really* more environmental risks today than there were 100 years ago, or does it just *seem* that way? Try to support *both* sides of this argument. Then tell which side you agree with.

6. In referring to environmental risks, the terms *toxic*, *carcinogenic*, *teratogenic*, and *genetic* were all used in the introduction. Explain what each of these terms means.

7. A synthetic product is more likely to pose a threat to human health than a natural product. Tell why you think this (either) may or may not be true.

8. Ultimately, every business is really self-regulating. A company that sells harmful products is "signing its own death warrant." When people find out the company's products are dangerous or defective, they will stop buying them. Is this true? Explain why you agree or disagree with this statement.

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Topic fourteen Whose job is it? Care for the mentally ill

Introduction

"Crazy, man!"

That phrase became popular during the Hip Generation of the 1950s. It was used to describe anything that was "cool," "fine," or unusually good. The same expression has been used, without the comma, by some groups of humans to label other groups of humans who are "insane," "strange," "weird," "mentally ill," or otherwise "different" from whatever it is that society regards as being "normal."

Perhaps the most interesting thing about insanity is the uncertain and changing way in which it has been defined throughout history. Many of us believe that we can tell when a person is "crazy" just by looking at him or her or by listening to the person talk. But experts have begun to point out how *subjective* such decisions are. Some people's behavior may become erratic ("abnormal") because of genetic or organic disorders. But most types of "insane" behavior can be explained much less easily. Some people simply prefer to be by themselves, have daydreams that are more realistic than those of others, or become overly depressed or lonely. Are people in this latter group "crazy"? Are they "insane"? Are they "mentally ill"?

The answers to such questions are not easy. Historians have shown us that large numbers of people once classified as "crazy" were probably *not* seriously disturbed by modern medical standards. They were, instead, individuals with physical defects, different religious beliefs, unusual social or political attitudes. Often they were simply men or women whose behavior was difficult to understand or to accept in the society of the time. It always helped (as it does today) to be very rich or a great artist. In these cases the "unusual" behavior could be excused as "eccentric" or "creative."

One of the most blatant modern examples of defining mental illness on social or political criteria has been the practice of the Russian government. Some troublemakers can easily be dealt with in an autocratic government like the Soviet Union. Prison, the firing squad, and exile to Siberia are quick and easy remedies. Others require more "delicate" or sophisticated treatment. A technique the Soviets have apparently found to be quite effective is to diagnose the troublemaker as "mentally ill." Then, he or she can be committed to a mental hospital until the person is "cured" or sees the error of his or her ways.

Among the dozens of examples of this form of treatment is that of the mathematician Alexander Sergeyevich Yesenin-Volpin. In the nineteen-year period between 1949 and 1968, Yesenin-Volpin was confined to mental institutions five times for his "anti-Soviet" beliefs and statements. He was diagnosed as "schizophrenic" and was released during his last sentence only because of the worldwide objection to such a blatantly political act by the Soviet government. The great advantage of this approach to solving political controversies is that the accused can be sentenced *in absentia* and procedural rights need not be observed. Also, since the attempt is made to show the person is "mentally ill," the question of guilt or innocence never arises. There is a certain frightening logic to the Soviet practice. The USSR is, the government claims, a "perfect" communistic society. At least, it is on its way to becoming one. All responsible citizens should be working with the party and the government to achieve that end. Anyone who argues against these goals or against efforts to achieve a perfect society must be "crazy." Case

closed! The disturbing thing about this argument is that it can probably be used by *any* government to silence dissent.

The horrors of mental illness have not been limited to the prison-like, inhumane hospitals of a few centuries ago or the mental/political nightmares of the Soviet Union. The United States, too, has had its share of incidents in which those who were truly mentally ill were closed up along with those whose only "defect" was that they were old, poor, or social misfits. Conditions in such institutions have seldom been very much better than those written about by Charles Dickens and other social critics more than a century ago.

As late as the 1960s millions of Americans were still to be horrified at these conditions when their attention was called to a "typical" Massachusetts mental hospital in a *cinéma vérité* film called *Titicut Follies*. We could hardly believe that a medieval institution like that hospital could still exist in the second half of the twentieth century in the "richest country the world has ever seen"!

All in all, however, treatment of the mentally ill has probably improved significantly in the past few decades. A landmark piece of legislation along the way was the Community Mental Health Center Act, passed by Congress and signed by President Kennedy in 1963. Observers praised the act for its "bold and imaginative" approach to the problems of mental illness. Emphasis would be placed, in the first place, on the *prevention* of mental problems at least as much as on their treatment. Further, efforts would be made to eliminate the "warehouse" approach to mental illness where patients are "hidden away" in remote "storage places." These would be replaced by halfway houses providing community-oriented supportive therapy. Patients would be helped to handle their mental problems within the context of their daily lives in the community. The aim of the bill was the closing of most state mental hospitals and the replacement of these by about 2,000 local community centers providing care, counseling, and education.

Ten years later, only half of the bill's objectives had been achieved. In fact, a large number of state hospitals *had* been closed. The inmate population in such institutions had dropped from 505,000 in 1963 to 276,000 in 1972. But the matching half of the plan had yet to be achieved. Only a little fewer than 400 of the planned 2,000 clinics had been opened. Of those, few were committed to the philosophy of mental treatment which inspired the 1963 act. In some, for example, only patients who could pay their way were accepted. Others seemed to be little more than private hospitals (built with federal funds) for the patients of staff psychiatrists. Almost none of the centers had developed the "bold and imaginative" community-centered mental health approach advocated by the 1963 bill.

The problem (as usual) seems to have been with money. Closing state mental hospitals was an appealing idea to state governments. It was not only a "humane" act, but also (and probably more important) it promised a significant financial saving. The construction of 2,000 new centers, however, represented a twofold difficulty. Not only did the 1963 act require a whole new approach to the care of the mentally ill, but it also required a heavy commitment of funds by the federal government to finance their construction. That money trickled out at first. But it never gushed out as it would have had to do to make the plan a success. Then, in 1973, the Nixon administration first decided to phase out any further support for mental health centers. Later it tried to impound money already appropriated for the program. Federal support for the "new approach" to the treatment of mental illness was dead. State support had long since dwindled to a minimum. And the future of the mentally ill in the United States was more in question than it had been in a long time.

Case Study: A halfway house

Four years ago, the Restwell State Mental Hospital was closed. Restwell was located three miles beyond the city limits in a quiet rural area. At the time it closed, just over 1,000 patients were housed in the facility. Eighty-five patients with the most severe disorders were transferred to Hockbeak Mental Hospital 150 miles from your city. The remaining patients were released to their families or friends, discharged to the care of private citizens, assigned to community mental health programs (CMHP), or simply discharged. Original plans had called for all patients to report to a CMHP for outpatient treatment on a regular basis. Limited funding, however, has made it possible for only about 100 of the original patients to receive care in the only CMHP in the city.

Three years ago, the state provided funds for a "halfway" house in your city to work with about seventy of the former Restwell patients. These would include the "next-most-severe" cases (compared to those transferred to Hockbeak). The halfway house would provide housing on a short-term (one- to three-week) basis, consultation, and medication. Patients to be treated at the halfway house include those who are most likely to cause social problems in the community.

At this point, the halfway

house has still not been established. At both of the two sites which have been selected, neighborhood opposition has been strong. People have argued that the presence of mentally disturbed patients in the area would present a threat to the neighborhood. Not only would the crime rate rise, they believe, but also property values would decrease. In each case, neighborhood opposition has caused the local CMHP to cancel its plans for the halfway house.

A third proposal has now been developed to locate the halfway house in an abandoned store three blocks from your home. Already opposition has arisen to this proposal, and it seems likely that the battle which has taken place twice before will be played out again.

The Buck Stops Here

As chairperson of the local neighborhood betterment league, you know that you will soon become involved in this controversy. Your organization will be urged to support or oppose the CMHP plan by friends and neighbors who live around you. Organize a meeting of the steering committee of the league. Decide what the arguments for and against the plan would be. Then prepare a position paper that tells how the league stands on this proposal and why it has taken the position it has.

Additional Questions

1. What is "normal" behavior in our society? Why is that an important (if somewhat difficult) question to answer?

2. The status of the community health center idea, at the time of this writing, is still unclear. Before you go any further with these questions and activities, see what has happened since this case has been written. Has the above dilemma been resolved? If so, how has it been settled? If not, what is the current state of affairs?

3. Suppose someone in your family is diagnosed as mentally ill.
   a. Who can properly make that diagnosis?
   b. How certain can the diagnosis be?
   c. What is likely to happen to the patient in your community and state?
   d. What kinds of facilities are available for the treatment of the mentally ill in your city and/or state?
   e. What changes have occurred in patterns for the treatment of the mentally ill in your state in the last decade? What effect has the Community Mental Health Center Act had?

4. Given the conditions described in the above case, what *specific problems* do you see with regard to the care and treatment of the mentally ill in the United States today?

5. One of the factors which made possible the community mental health center idea was the discovery that certain drugs can be used to treat the mentally ill. See what you can learn about drug therapy for mental disease.

6. What do you think it means to be "insane"? What does the term "mental illness" mean? Are the two definitions the same? (Compare with your answer to question #1 in this series.)

7. Are there various *kinds* of mental illness? If so, what are they? What methods can/should be used to treat each type?

8. Can you think of any examples of behavior in "normal" people (politicians, teachers, artists, religious leaders, for example) which might be regarded as "insane" if it occurred (a) at some other time, (b) in some other place, or (c) among less "established" citizens (e.g., among the very poor or very old)?

9. See if you can find out if *our* government has ever used "mental illness" as a means of penalizing political dissenters. (Examine, especially, the case of the poet Ezra Pound following his return to this country after World War II.)

10. Some statistics say that the total number of mental patients seen in American hospitals amounts to almost 850,000 per year. How can you reconcile this figure with the estimate of 276,000 given in the above case? What is the significance of the answer you find for this discrepancy?

11. Some people would say that insanity is whatever the majority of people (or the government) *says* it is. If that's true, maybe it could be argued that the Soviet Union is both legally and morally correct in defining political dissenters as "mentally ill." Maybe a person perhaps *is* crazy to think he or she can argue with or change the political system there. What do you think?

12. At the turn of the century, the two most serious "mental health" problems were

masturbation, and "hysteria" in females. The latter term applies to the condition in which women seem to be nervous, aggressive, anxious, or, in general, behaving in "unladylike" ways. Find out why these two problems were regarded as such serious forms of "mental illness." What was done about people with one or the other of these "mental afflictions"? What is our official position on the mental health or mental illness aspects of masturbation and hysteria today?

13. One of the most remarkable medical cures in all history occurred in 1973. At that time the American Psychiatric Association (APA) removed "homosexuality" from its list of mental illnesses. Overnight some 20 million homosexuals in the United States were "cured." This "cure" was somewhat complicated by the fact that the American Psychological Association did not change its position on homosexuality until a year later. In 1978 a vigorous debate in the APA once more centered on this question. Many psychiatrists argued that homosexuality ought to be put back on the list of mental illnesses. What does this brief history suggest to you about the meaning of "mental illness" in the United States?

14. We now say people are "mentally ill," not that they are "mad" or "insane." That suggests that we now have a better *medical* understanding of this problem. In what ways is *mental* illness like *physical* illness? In what ways are the two different? What do your answers to this question suggest about the nature of "mental illness"?

15. Thomas Szasz has written extensively about "the myth of mental illness." Find out what that phrase means. What is its significance to this discussion?

16. A great deal of research has been done in recent years on the connections among madness, insanity, mental illness, heresy, sin, and witchcraft. To begin with, write out your own definition for each of these terms. Do they all mean nearly the same thing? Some scholars say that these terms are all used to describe behavior which is "different" from that prescribed by society. Find out what evidence exists to support that idea. How does the United States in the 1980s deal with people who don't think or behave according to society's rules?

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Topic fifteen
The new 'plague': AIDS

Introduction

The most serious public health problem in the United States and Canada today is a disease which was unknown twenty years ago. The disease didn't even have a name until 1981! Acquired immune deficiency syndrome (AIDS) is the somewhat imprecise name by which this disease is now known.

AIDS is caused by a virus which enters a person's body and attacks the immune system. Over a period of time, the immune system is disabled or destroyed. The body is unable to fend off even the simplest infection and, apparently without exception, death results.

AIDS first came to the attention of medical workers in the U.S. in 1981. Physicians in New York City began to diagnose a surprisingly large number of cases of Kaposi's sarcoma (KS). This form of skin cancer had previously been found primarily among older men of Mediterranean descent. But the KS patients in New York were men in their twenties and thirties. Before long, doctors recognized that all of their KS patients had one characteristic in common: They had engaged in homosexual sex.

The disease pattern among the New York KS patients was remarkably similar. Most reported an increased susceptibility to flu, colds, and other simple infections. Over time, these infections grew more serious, occurred more often, and lasted longer. In each case, it appeared that a patient's immume system—his body's natural defense against infections—had weakened and eventually failed. Within a period of a few months patients developed more serious infections, KS, or a form of pneumonia known as Pneumocystis carinii. These diseases generally caused the death of the patient.

Since its first appearance in New York in the early 1980s, AIDS has spread like wildfire throughout the U.S. and Canada. It has reached epidemic proportions in at least four states (New York, California, New Jersey, and Florida) and has claimed victims in all 50 states and Canada. Of those who developed AIDS, the vast majority (80–95%) are gay or bisexual males. The next largest group at risk includes drug-users who have shared needles. The remaining fraction of AIDS patients includes individuals (often hemophiliacs) who require blood transfusions and babies born to a parent with the disease.

By the end of September 1986, 25,650 men and women had contracted AIDS. Of this number, 14,345 had died. The death rate from the disease appears to be 100%, or very nearly that great.

In addition, as many as 200,000 individuals may have a condition known as AIDS-related complex (ARC). ARC symptoms are similar to, but less severe than, those of AIDS itself. It appears that some (but not necessarily all) patients with ARC will eventually develop AIDS itself.

Further, some experts feel that as many as 2,000,000 men and women in North America have been exposed to the AIDS virus at some time in their lives and are now carrying antibodies to the disease. Since the latency period (the time for the disease to express itself in the body after an initial infection) may be at least five years, the possibility exists that many ARC patients and individuals with AIDS antibodies may still develop the disease.

We now know that AIDS is caused by a virus (or a group of closely-related viruses) not entirely different from those viruses that cause hepatitis, the flu, and the common cold. The virus is known by one of three names: HIV, ARV or HTLV-III. HIV attacks a particular kind of cell in the body, a T-4 lymphocyte. T-4 lymphocytes are cell "supervisors"who direct and control the body's immune system. They help mobilize the immune system against bacteria, viruses, and other microorganisms that may enter the body and cause disease.

The AIDS virus works much as any other virus does. It (1) attaches to the outside of a cell (the T-4 lymphocyte in this case), (2) passes into the cell, (3) takes control of the cell's biochemical functions, and (4) begins to make copies of itself. In the case of the HIV, the time between steps (2) and (3) may range from a few weeks to at least five years.

Once the cell begins to reproduce new virus particles, it releases those particles to the bloodstream and dies. Virus particles are then carried in the bloodstream to other cells, which they may infect.

An interesting characteristic of the HIV is that it tends to become active [steps (3) and (4)] when T-4 cells begin to reproduce. That is, suppose that the body is infected by a microorganism. The body's normal reaction is to start producing more T-4 cells to fight this infection. But as soon as T-4 cells begin to reproduce, any HIV within those cells become active. The *more* T-4 cells are produced, the more will be destroyed and the weaker the body's immune system becomes.

Thus, people do not die from AIDS itself, but from some infection (often called an "opportunistic" infection) against which their bodies cannot fight. Infections which a normal person's immune system could easily destroy become life-threatening for the AIDS patient.

In fact, the most common causes of death among AIDS patients are a form of pneumonia (Pneumocystis carinii) and an otherwise rare form of skin cancer (Kaposi's sarcoma).

The world has seen many terrible epidemics in its history: leprosy in Egypt in about 4000 B.C., the Antoine plague of ancient Rome, and the "Black Death" of the Middle Ages. From a medical standpoint, none has been as serious as AIDS. As best we can tell, nearly *every* patient with the disease will die. The body is unable to defend itself, and scientists have yet to find a vaccine with which to prevent the disease. Compare this with the hideous Black Plague of the Middle Ages, when no more than 25% of people infected actually died.

AIDS is unusual in another respect, namely the populations which it most commonly afflicts. Gay and bisexual men and drug-users are regarded by many in our society as social pariahs, deviates, perverts, criminals, or sinners. For some in the general public, AIDS is seen as a disease "the gays had coming to them." Some religious leaders, in fact, have taught that AIDS is "God's punishment" for those who engage in homosexual acts.

Perhaps the greatest fear in the general population is that AIDS will spread from the gay-bisexual-drug population to the nongay, non-drug, heterosexual population. This fear has prompted many individuals to avoid any contact with AIDS patients and, in fact, with gay and bisexual men entirely. Proposals have even been made to identify and quarantine anyone whose body contains antibodies to the AIDS virus.

Case Study 1

Arnie B. is eight years old and would normally be entering third grade at the Nottingham School this fall. However, his school plans are currently "on hold." The reason is that Arnie has just been diagnosed as having AIDS. Arnie is a hemophiliac and appears to have contracted AIDS through one of the blood transfusions that he must have on a regular basis.

At this point, Arnie's parents are insistent that he be allowed to enter school in two weeks, as planned. They point out that the Center for Disease Control (CDC) has indicated that AIDS is transmitted only through the exchange of body fluids, especially semen and blood. No case is known, they argue, in which AIDS has been transmitted through any kind of casual contact. No other student in Arnie's school would be at risk as a result of Arnie's attending classes.

Some of the other parents with children at the Nottingham School are not so sure about this argument. They understand the terrible nature of AIDS, that chances of an AIDS sufferer's recovering from the disease are essentially zero. They remind school officials that no medical authority, including the CDC, is willing to guarantee absolutely that other children are completely safe from contracting the disease. They feel that Arnie must not be allowed to enter school this fall.

The school committee is caught in the middle of this debate. On the one hand, members of the committee tend to agree that the risk of transmitting AIDS in this case is small. Still, as a political group, they are sensitive to the objections of those who want to ban Arnie from school. They know that the most vocal members of the school community are likely to withhold their children from the school. This would be a terrible situation, both from the standpoint of children's education and of the school committee's political image.

As a compromise, the committee has offered to provide Arnie with a direct telephone hook-up to his classroom. He would be able to get every bit the same education, they say, that he would get by actually being in the classroom. Arnie's parents disagree. They think that he will miss out on all the personal contacts he would have were he in the classroom. They have refused the committee's compromise offer.

The Buck Stops Here

School opens in two weeks. The school committee has to make a decision before that time. As a member of the school committee, what suggestions do you have for the resolution of this dilemma? Prepare a one-page written paper that (a) outlines your suggestion and (b) explains the basis for this suggestion. Share your opinions and ideas with other members of the class and come up with a satisfactory recommendation that will resolve the current dilemma.

Additional Questions

1. Summarize the scientific evidence we have on the ways in which the AIDS virus is transmitted.
2. Are people likely to make a decision on Arnie's case based on your answer to question #1 above? Why or why not?
3. Arnie was obviously an innocent victim in this case. By pure chance, he received blood from an infected person. Assuming that the private insurance carried by Arnie's parents will cover only a fraction of his medical bills, who should be responsible for the remainder of his expenses? Explain and defend the choice you make.
4. Suppose that AIDS affected primarily each of the following groups. In each case, how might the story of AIDS be different (if at all) from what it is now?
   a. Black females between the ages of 12 and 21
   b. Workers in nuclear power plants
   c. X-ray technicians
   d. White males between the ages of 30 and 49 of German descent
5. What is the current status of research on a vaccine to protect against AIDS?
6. How are AIDS patients treated medically? That is, what drugs, surgery, or other treatment is available for the cure or treatment of this condition?
7. Some forms of sexual relations are less likely to result in the transmission of the AIDS virus than are others. These forms have been called "safe sex." Should information about "safe sex" be made available to (1) high school students, (2) college students, (3) the general public. Explain your answer to each of these options.
8. A local postmaster in Maine is reported to have returned mail containing educational pamphlets on AIDS on the grounds that the topic was "obscene." Tell why you would or would not agree with this action.

Case Study 2

United Services (US) is a large electronics manufacturer with plants throughout Canada, the U.S., and the rest of the world. One of these plants is located just outside of Toronto. Vera Wiley, Regional Vice President for US, is concerned about the spread of AIDS in the Toronto area. She knows that this area has the highest rate of AIDS cases, per capita, in Canada, and one of the highest in the world.

She fears that the likelihood of US' employing AIDS patients is very high. She and other employees are worried that daily contact with AIDS patients might cause the disease to spread through the whole plant. Simply as a matter of wise public health policy, Ms. Wiley objects to having AIDS patients in the plant.

To resolve this problem, Ms. Wiley proposes that all present employees and all new applicants at US-Toronto North be tested for AIDS. One test, called ELISA, was developed to test for the presence of AIDS antibodies in the blood donated at blood banks. The test is normally about 80–90% accurate, but reveals only whether *AIDS antibodies* are present. The presence of these antibodies is not predictive. That is, about 80% of those who have tested positive with ELISA have *not* (at least as yet) developed the disease.

The use of ELISA to screen for AIDS patients is, therefore, somewhat dubious. It is, however, the only test which can be used in this situation. All factors considered, Ms. Wiley feels that it will be better to be safe than sorry, and she continues to recommend ELISA as a screening tool at US.

The Buck Stops Here

Under the present work contract, the Steering Committee of Union 743 at US-Toronto North is entitled to approve or disapprove of any changes in work rules. Ms. Wiley's recommendation is such a change and requires, therefore, action by the Steering Committee. As a member of the union Steering Committee, decide whether you tend to favor or oppose Ms. Wiley's recommendation. Obtain as much evidence and expert opinion as you can to support your position. Working with other union members (class members), try to hammer out a policy statement with regard to the employment of AIDS patients at your plant.

Additional Questions

1. Some states and communities have considered the possibility of using ELISA to locate individuals with antibodies to AIDS. Those who tested positively on ELISA would (1) have their names sent to the state or city department of public health, and/or (2) be quarantined, and/or (3) be prohibited from holding certain jobs. Tell why you think that each of these is or is not a legitimate use of ELISA. Explain your decision in each of these three cases.

2. Does it make any difference to you *which job* is meant by point (3) in Question #1 above? Explain.

3. AIDS is a communicable disease. Define a communicable disease. List four other communicable diseases. Is AIDS now being handled in our society like other communicable diseases? Find examples or evidence to support your answer. *Should* it be handled like other communicable diseases? Why or why not?

4. Some insurance companies are very concerned about the spread of AIDS. They paid out more than $16 million in AIDS-related claims in 1985 alone, and have every reason to believe that this amount will go much higher in the future. Thus, they hope to find a way of screening out applicants who are at risk for AIDS. By what mechanism(s) have they/could they put such a policy into effect? Do you believe that insurance companies *can* and *should* implement such a policy? Why?

5. As a real estate agent, you are attempting to sell a condo owned by a man who died of AIDS two months ago. Do you have any legal, social, or ethical obligation to mention this fact to prospective buyers? Why or why not?

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Topic sixteen
Solving problems of infertility

Introduction

For most humans, making a baby is one of life's simplest and most natural acts. One doesn't need a high school or college diploma in order to reproduce. No lessons, licenses, or special skills are required to produce another human life.

Yet, as many as 15% of all married couples (nearly three million men and women) in Canada and the United States are unable to have children of their own. Either husband or wife—or both—is infertile. Until fairly recently, the only way such couples could have a family of their own was by adopting a child.

As far back as the 1700s, however, scientists began to investigate alternative methods of reproduction. The first of these methods, artificial insemination (AI), can be used for those women whose reproductive system is, for any one of a number of reasons, inhospitable to sperm. A typical situation is one in which a woman's cervix is incorrectly shaped, making it difficulty for sperm to reach the ovum.

A common AI procedure in such a case is to introduce sperm mechanically (e.g., with a syringe) directly into the uterus. Children conceived by this form of AI are the true biological offspring of the man who provided the sperm and the woman whose ovum was fertilized. Experts estimate that somewhere between 10 and 20 thousand children each year are conceived by means of AI. They believe that at least a quarter million babies have been conceived by this technique in this century.

The procedure described above is satisfactory when infertility results from a problem with the woman's reproductive system. In many cases, however, infertility results from problems with the man's sperm. The sperm may be too few in number or not robust enough to reach and fertilize the egg. AI carried out by this procedure will not resolve this problem.

In such a case, one possible solution is to use sperm from a man other than the prospective father. This sperm is collected from the "donor" father and introduced into the prospective mother's uterus. AI using "donor" sperm was first attempted in the 1890s and is responsible today for about 8000 births in the U.S. each year.

Social, legal, and ethical problems associated with donor AI are somewhat complicated because the child has one mother and two fathers, the biological father and the father who raises the child.

Yet another reproductive problem arises when a woman is unsuccessful in carrying a fetus to term. A malformed, scarred, or damaged uterus may prevent a fertilized egg from implanting and/or growing normally in the womb. One solution to the problem is the use of a surrogate mother. Eggs from the prospective mother are fertilized by her mate's sperm, either in her body (*in vivo*, or outside her body (*in vitro*). The fertilized eggs are then removed surgically (or taken out of the laboratory glassware) and transferred to the uterus of a second woman, the surrogate mother. If all goes well, the fertilized egg grows and develops within the surrogate mother who bears the child and returns it to its "parents."

A variety of problems can arise from the use of surrogate mothers. As with donor AI, the child has at least three parents: the surrogate mother and the man and woman who raise the child. In fact, should both husband and wife be infertile, one can imagine a total of five parents:

One can imagine a number of issues that might arise from this situation. For example, does the donor male have any legal rights (e.g., of visitation) with respect to "his" child? What happens if the surrogate mother decides that, after carrying another couple's child for nine months, she wants to keep the baby?

Within the last decade, technology has made available even more ways of making a baby. Probably most exciting—and most controversial—is *in vitro* fertilization. The term *in vitro* is Latin for "in glass," and refers to the process by which an egg and sperm are combined outside the human body, in laboratory glassware. From this procedure comes the somewhat inaccurate term "test-tube babies." The world's first test-tube baby, Louise Brown, was born in England on July 25, 1978.

Less than a decade later, more than 100 clinics in the U.S. and Canada had been established to provide test-tube reproduction for couples who have been unable to conceive naturally.

Many authorities believe that the progress we have made in artificial reproductive techniques is only the beginning. Even more advanced and more sophisticated procedures appear to be on the horizon. One example is cryopreservation.

In cryopreservation fertilized and/or unfertilized eggs and/or sperm are frozen and stored for long periods of time. This means that a man who decides to have a vasectomy today could still father a child (by way of his frozen sperm) six months, a year, or ten years from now. By 1986, clinics in Australia (where the procedure was developed) had already produced a dozen babies from embryos which had been frozen for some period of time.

One again, the new technology has raised a host of ethical and social questions. Typical of these was the controversy that arose when Elsa and Mario Rios died in a plane crash in 1983. At the time of their death, two frozen embryos—produced from his sperm and her eggs—lay frozen in an Australian lab. Who now "owned" these fertilized eggs? Should they be allowed to die? If so, would that be a case of murder? Would any children born from these eggs be orphans? Would they be entitled to the Rios' estate? As we progress in reproductive technology, questions such as these become increasingly common and difficult to answer.

Case Study

You and your mate have been trying to have a child for five years, so far without success. Your physician has been unable to determine which of you (if not both) is infertile. At this point, it seems clear to both of you that a natural pregnancy is unlikely to occur.

After much discussion, the two of you have decided not to pursue adoption. You will continue to explore methods by which you could have a "child of your own."

The Buck Stops Here

In this case study play yourself. List all methods by which you and your (true, prospective, ideal, imaginary) mate might be able to have "your own child." This list might include, but not be limited to, the technologies described above. You will probably want to read current articles on this topic and, perhaps, interview an expert in reproductive technologies.

When your list is complete, state the advantages and disadvantages of each technology. Remove from the list any technologies that are unacceptable and explain why you've removed that technology. Finally, arrange your list in order, from most appealing to least appealing method. Be prepared to tell why you've chosen the sequence you have.

Alternatively, you may decide to use no artificial form of reproduction whatsoever. In such a case, explain why you have made this decision.

Additional Questions

1. Where does adoption belong in this discussion? That is, given the fact that many couples want babies of their own and that many babies are unwanted, why can the desires of the former not be met by the supplies of the latter?

2. "Any technique other than the natural act of coitus between a man and a women is against

God's will and is, therefore, morally unacceptable." Comment on this position.

3. What ethical, legal, social, economic, and/or psychological problems can you foresee in the use of a surrogate mother?

4. Suppose you were director of the clinic in which the Rios' frozen embryos were stored. What action would *you* take with regard to these embryos? Why?

5. Select any one of the reproductive technologies described above and find out the specific steps involved in the technology. Prepare a poster or report summarizing what you learn.

6. What success rate is associated with each of the technologies mentioned above? What social and/or ethical questions (if any) are raised by your answer to this question?

7. What psychological issues (if any) might trouble (1) the "parents" (defined in any way you like) who select and (2) the children produced by the technologies described above? How would *you* react if you learned that you had been a test-tube baby?

8. A single woman decides to have a child, using AI with the sperm of a male friend. How, if at all, is the state concerned with this act? What advice, if any, would you have for this woman?

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part two

Issues from the physical sciences

Topic one
How many ways can you kill a lake? Water pollution

Introduction

Some environmental problems are easier to ignore than others. Not many of us will be affected directly if the bald eagle becomes extinct. Excess noise may be irritating at times, but we tend to become accustomed to noise pollution. Food additives may well pose a threat to our health, but a long-range threat we don't worry about very much. But water pollution: now *that's* another matter. It's hard to ignore the contamination of our water when tap water foams with suds like a freshly opened bottle of beer, when you can't go swimming because the beaches are polluted, and when you have to keep your windows closed on a hot summer night because the river running in front of your house stinks so badly!

What precisely do we mean by "water pollution"? Contamination of water can be classified as one of three types: physical, chemical, or biological. Those worn-out tires, rotting planks of lumber, rusty old cans, and other trash floating down the river or buried along its banks are examples of physical pollution. This is nothing more than the junk and debris that has been dumped into a waterway. It may range in size all the way from enormous discarded oil drums to tiny fibers of waste paper dumped into a river. This type of pollution looks and sometimes smells quite bad, but it's usually the least of our worries in contaminated rivers and lakes.

More dangerous are the chemical wastes that find their way into our water. Mining, industry, farming, and private homes all dump substances which are—or can be converted to—poisonous compounds. The runoff from mining regions, for example, generally contains sulfur compounds which may be oxidized and then changed into sulfuric acid. In even relatively low concentrations this compound is toxic to almost all forms of animal and plant life. Rivers downstream from mines and smelters maintain fish and aquatic populations, therefore, only with the greatest difficulty. Nitrates, phosphates, pesticides, and other artificial compounds used by farmers are easily and regularly leached from the soil and carried away into streams and lakes. Those materials which are not directly harmful to fish and animal life may contribute to the eutrophication (the support of undesirable plant and animal growth) of bodies of water.

Finally, a critical component of polluted water includes various types of biological material. Bacteria, viruses, and many kinds of protozoa may enter water from municipal sewage or commercial wastes. Farms and ranches which maintain large herds of livestock and thus produce large amounts of manure, are also likely to make significant contributions to water contamination.

Simply naming the forms which water pollution may take goes a long way toward identifying the sources of this problem. Municipal sewage is one such source. Garbage and human wastes dumped into a river or lake are normally acted upon by bacteria which live in the water. Given an adequate amount of time, these bacteria will decompose wastes into harmless products, carbon dioxide, and water.

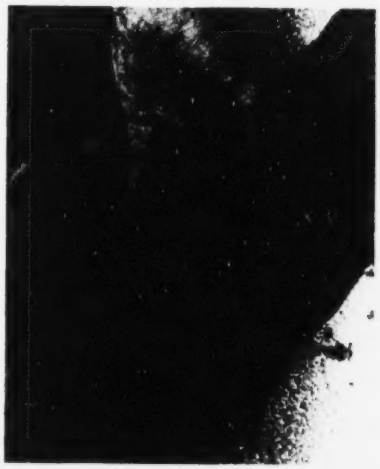
In this respect, natural water supplies are essentially able to cleanse and purify themselves. When the quantities of waste become too great for bacteria to act on, however, wastes build up, decay begins, and pollution results.

Farms are a second obvious

source of pollution. We've already described how animal wastes, fertilizers, and pesticides can get into the water supply. Soil that is washed away may also end up as sediment in rivers and lakes. The interesting point here is that the more modern, advanced, and technologically up-to-date a farmer is, the more likely he or she is to contribute to water pollution. Progress, by one definition, then, represents a step backward by another definition.

Industry is a third cause of water pollution. Factories and manufacturing plants use water for a thousand and one purposes. One major purpose is simply to carry away the waste products of various manufacturing processes. In almost any manufacturing process there are many substances formed for which industry has no further use. The simplest and cheapest way for factories to get rid of these wastes is just to dump them into some body of water. The danger, of course, is that the discarded wastes often contain materials which are harmful to plants, animals, and humans: acids from tanning operations, metallic mercury from chlorine plants, bleaches from paper mills, and so on. A recent study of the presence of heavy metal wastes in the Rhine River produced some astounding results. Each month about eighty tons of arsenic, 300 tons of copper, twenty tons of cadmium, and ten tons of mercury passed through the Netherlands at the mouth of the Rhine. This mess of poisonous soup had apparently been created as industries along the river dumped their wastes into the most convenient sewer available, the Rhine. American industry often uses the same procedure and rivers like the Potomac and lakes like Lake Erie are mute witnesses to the results of these irresponsible practices.

There probably has been more concern about air and water pollution than about any other social problem of science. This has resulted in legislation in these areas far beyond that in less popular causes such as genetic engineering and behavior modification. One landmark piece of legislation was the Water Quality Improvement Act of 1970, passed by the United States Congress. The act contained a number of provisions among which were standards for control of ocean pollution by oil-carrying vessels, authorization for demonstration projects on control of acid and mine water pollutions, provision for improvement of water quality in the Great Lakes and their watershed areas, and establishment of an Office of Environmental Quality. A total of $406 million was authorized to carry out the conditions of the act. This was one of the first significant major commitments by the federal government in its war against environmental pollution.



"There is no way to avoid shipping large amounts of oil across the ocean in tankers. There is no way to avoid accidents from time to time. Thus, it is impossible and unreasonable to expect oil spills like this one will never happen. What this means, then, is that the pollution of the oceans by oil spills is not really a 'problem' since it is unavoidable." Comment on this line of reasoning. (top photo courtesy of the U.S. Coast Guard; bottom photo courtesy of the Environmental Protection Agency)

The following case studies deal with three aspects of the problem of water pollution. The first concerns the risks of oil spills. As we increase the amount of off-shore drilling and the volume of oil transported by super-tankers, the dangers of massive oil spills becomes greater. What is an acceptable trade-off between these risks and the benefits of improving our supplies of oil?

The second question deals with the responsibilities for pure water. The pollution produced by town A may be more of a problem for town B than for town A. In such a case, who should monitor, control, and pay the costs of polluted water?

The third case involves a somewhat different form of water pollution: thermal pollution. Water used by power plants and factories is often returned to lakes and rivers somewhat warmer than when it was taken out. What risks are associated with this practice? How acceptable

are these risks in comparison with the benefits offered by the power plants and factories?

Case Study #1: Oil spills: Your choice: No jobs in town or junk in the harbor?

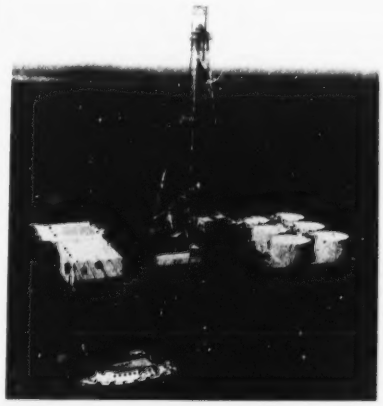
The northeastern states may be the section of the country to feel an energy pinch first and with greatest severity. The Boston-New York-Washington megalopolis contains the greatest concentration of population anywhere in the United States. Although oil and coal fields in Pennsylvania, West Virginia, and other Appalachian states have long satisfied the energy needs of this region, they can no longer do so for two reasons: too many people and too few reserves. Like many other metropolitan regions, the Northeast is finding it increasingly necessary to look to more distant sources—the gas fields of Texas and Louisiana, for example—for their fuels.

One such distant source which has become an important part of the energy equation is the crude oil available from overseas, especially from the Middle East. Northeastern states already import up to 25 percent of their petroleum supplies from outside the United States, and in recent times of shortage, increasing petroleum imports has been the only way to hold off "fuel starvation." In looking toward the future, these states must certainly plan for ways of handling still larger shipments of crude oil from foreign ports.

Currently most incoming petroleum arrives in the New York City-Newark area, at refineries along the Chesapeake Bay, or at Boston storage tanks. Pollution of coastal areas at these points has become so severe—both on land and in the water—that further expansion of receiving terminals is inadvisable.

One proposal is that an entirely new oil tanker terminal be built near Harvis (a fictitious name) on the northeast coast of Maine, about 350 miles north of New York City. Proponents of this plan offer a number of advantages. First, the terminal could be built along a relatively remote section of the coastline, away from any heavy concentrations of population. Any oil spills or other accidents which might pollute ocean and beaches would affect the minimum possible number of people. Second, the terminal could be an enormous economic asset to the state of Maine. Heavily dependent upon farming and tourism, the state is industrially one of the least developed of the fifty states. The terminal would likely be a "shot in the arm" to Maine's business and economic community. Hundreds or even thousands of jobs might result, providing taxpayers with a welcome relief from skyrocketing welfare costs. Third, as an entirely new facility, the Harvis tanker terminal could be built to handle the 300,000-ton supertankers now being constructed. This would be an advantage that many existing ports could not offer.

Opposition to the proposed tanker terminal has been vigorous. Opponents offer the following arguments to counter each of the proponents' points. First, while Harvis *is* in a remote part of the state, there are almost 150,000 residents living within a fifty-mile radius of the proposed site. Furthermore, the region is a popular tourist attraction. Mt. Capstar National Monument, twenty-two miles from Harvis, attracts more than 70,000 visitors each summer. Pollution of the beaches and oceans around Harvis would be not only aesthetically offensive, but would do great harm to tourism and coastal fishing activities. Second, citizens of Maine have always prided themselves on living in one of the few unspoiled regions



An oil company is interested in drilling for oil in valuable fishing grounds off a populous New England state. What reasons would there be for the state to encourage this project? What reasons would there be for it to oppose such a project? What agencies, groups, or individuals, should be involved in making this decision? (photo courtesy of the U.S. Department of the Interior, Bureau of Land Management)

of the country. Many people have moved to Maine to get away from industrial "progress," and the Harvis project would bring Maine exactly the same environmental problems they originally tried to get away from. There should be *some* place in this country to get away from those problems! Finally, the thought of mammoth supertankers is enough to multiply environmental concerns many times over. An accident involving a ship of that size would make the loss of 30,000 tons of oil from the *Torrey Canyon*, for example, seem like a minor affair. Pollution from even the normal activities of a

tanker this large—activities like dumping of the ship's sewage, loss of oil during unloading and cleaning of tanks—should *of themselves* create a serious ecological threat.

The choice confronting Maine residents is the same one so often arising in environmental issues like this one: jobs, economic profit, and pollution versus unemployment, economic stagnation, and protection of the natural environment.

The Buck Stops Here

As a resident of Harvis, would you favor or oppose this project? Why?

Additional Questions

1. Many points made by those engaged in this controversy are matters of judgment or opinion. Some, however, are not; they are matters of fact. Go back through the above arguments and see which statements can be contested on *factual* grounds, and which have to be argued on *philosophical* grounds. (As for example: We could say that arsenic is poisonous to humans and, therefore, they should not eat it. The first half of that statement is a "fact" and is not debatable. The second half is *not* a matter of fact, but an opinion which could be debated.)

2. As a resident of Portland, largest city in Maine and less than 100 miles from Harvis, what reasons would *you* have for supporting or opposing the construction of the tanker terminal?

3. As a resident of Harvis, what special benefits or disadvantages would the terminal provide you and your community?

4. What arguments, either pro or con, could be offered in addition to those provided in Questions 2 and 3?

5. Assume for the moment that you *oppose* constructing the terminal. The fact remains that oil imports *will* have to be increased in the next few years. If the terminal is not to be built at Harvis, where should it go?

6. See what you can learn about the damage done to our coastline by oil spills. How do such spills occur? What damage do they do? How can they be cleaned up? What specific examples (like the "Torrey Canyon") can you find? Are such spills becoming more, or less, of a problem?

7. To what extent and in what ways does oil pollution represent a threat to the open seas? To the Great Lakes? To any other bodies of water across the country?

Case Study #2: Downriver pollution: "My brother's keeper . . . ?"

Donald's Creek is a small, but growing community in the upper Midwest. It's located on the Wahatapouchee River, a tributary of the Missouri. Donald's Creek was settled as a farming and ranching community and for over 100 years its population fluctuated around the 4,000 mark. Since the founding of a new branch of the state university three miles from town in 1975, however, population has been booming. The 1978 state census recorded 9,563 citizens, and that count increased to 12,875 in 1986. Projections are that there may be as many as 40,000 residents of the Donald's Creek area by 1994.

This sudden increase in population has created many new social, economic, and environmental problems for the citizens of Donald's Creek. Among these is the pollution of the Wahatapouchee. Until 1965 the town's sewage disposal program consisted of dumping untreated sewage and wastes into the river. The volume of wastes was small and the river was effectively able to remove them without becoming contaminated. Now, growth has occurred so fast that the town has been unable to construct a new sewage treatment plant, so the previous practice of dumping untreated wastes directly into the river continues.

As a matter of fact, the citizens of Donald's Creek have not experienced any serious water pollution problems. To be sure, the residents of little Buffalo Bend (population, 2,500) ten miles downstream on the Wahatapouchee, have begun to complain about the fouling of the river. But the river is still essentially clean within the boundaries of Donald's Creek itself. Besides, there is reason to believe that the Buffalo Bend problem is largely due to wastes discharged from the Penanpensel Paper Company factory, four miles downstream from Donald's Creek. In any case, the citizens of Donald's Creek can't understand the anger and concern of the citizens of Buffalo Bend.

The state, however, has taken a stand on the issue. Although its field analysis of the Wahatapouchee is not complete, the state water commission has announced that *at least part* of the pollution of the river in Buffalo Bend is due to untreated sewage being dumped at Donald's Creek. They have, therefore, ordered the town of Donald's Creek to construct a tertiary sewage treatment

plant within the next year. Failure to comply with the order will result in a fine of $5,000 per week to the town of Donald's Creek.

Complaints about the state's action have arisen in various segments of the Donald's Creek community. Members of the chemistry department of the state university say that the water commission acted before it had definite data on the extent to which Donald's Creek was causing the problem at Buffalo Bend. A number of citizens are appalled at the estimate of $4 to $5 million for the construction of the new plant, and many are suggesting that they would rather pay the fine than support the cost of a new treatment plant. Finally, members of the township commission have received some indication from state representative Glackinski's office that the governor will appoint a new water commission next year, and the present decision may be set aside. All in all, the town has unified itself in opposition to the construction of the new sewage plant.

The Buck Stops Here

As a resident of Donald's Creek, would you vote for or against the construction of this water treatment plant? Explain your decision.

Additional Questions

1. In further preparation for a decision on this problem, find out the procedures involved in primary, secondary, and tertiary treatment of sewage. Which level is appropriate for which situations?

2. If you were a citizen of Donald's Creek, what arguments could you offer *in favor of* the construction of the sewage treatment plant? What additional arguments against construction are there?

3. As a resident of Buffalo Bend what arguments would you present to the township commission of Donald's Creek for construction of the plant?

4. Who is "right" and who is "wrong" in the story told above? Explain why each party is, in your judgment, either "right" or "wrong."

5. How should state governments deal with a community like Donald's Creek which refuses to take actions necessary to protect the environment?

Case Study #3: Thermal pollution

Energy resources are as much of a problem in Gussey's Gap as they are anywhere else in the nation. Oil and natural gas are in short supply, of course. That which is available is very expensive because costs of transporting the fuels is so high. Coal is more abundant, but the citizens of Gussey's Gap strongly object to the increased air pollution that will result from the use of the low-grade coal that is mined nearby.

A proposed solution has been offered by the Isotope Nuclear Power Company (INPCo). INPCo proposes building a nuclear power plant on the shores of the Great Slave Lake and selling electric power to the town of Gussey's Gap. The plant should be able to meet the town's electrical needs for the next forty years.

The problem is that construction of nuclear power plants has become a very complex matter. In addition to technical problems, engineers must be concerned about stringent safety requirements, disposal of nuclear wastes, and many other health and safety considerations. INPCo thinks it has resolved most of these issues. The major problem still remaining concerns water used for cooling the reactor. The proposed plant will require about 60,000 liters (16,000 gallons) of cooling water *per second*! This water will be drawn from the lake, passed through the reactor, sent to cooling towers, and then returned to the lake. Engineers estimate that the used water will be no more than 4° C warmer when it is returned to the lake compared to its temperature when removed.

Members of the local Sierra Club and Audubon Societies strongly object to this plan. There is ample evidence, they say, that very warm water can be harmful to a lake or river. First, warm water can hold less oxygen than can cooler water. Aquatic animals which depend on oxygen for life (and most of them do) may be harmed or killed. Second, raising the temperature of a body of water may encourage decay or growth of lower organisms. If this happens, the normal ecological balance of a body of water may be drastically changed.

It's true, critics admit, that temperature changes normally produced by thermal pollution are much smaller than those we know will produce definite and drastic changes. We do know, for example, that a ten-degree rise in water temperature may kill all or most of the fish in a lake. But what happens if the water temperature rises only a tenth of one degree? The answer to that question is that we're just not sure. Although studies of the effects of thermal pollution on aquatic environments are constantly going on, there is still a good deal of uncertainty as to *exactly* what results are produced by various changes in water temperature on various organisms.

Conservationists have taken this uncertainty to mean that we should go slowly on the building of new power plants that use large amounts of water for cooling. We should hold off on such construction until we are sure we know what effects these plants will have on fish and other aquatic life.

Plant officials agree with this statement, but say that the temperature changes produced by the plant's use of water will be much less than the level at which damage is likely to occur. Besides, they point out, the cost of bringing used water back to its original temperature is very high. For each additional degree of cooling, plant construction costs will increase by about $5 million they say. These increased costs would have to be recovered by increasing the cost of electricity sold to residents of Gussey's Gap.

The suggestion that we hold off on building new power plants, the company insists, is a luxury we cannot afford. Our power needs continue to grow unabated, and we simply must find ways of producing more and more electricity. Nuclear power plants—even with their threat of thermal pollution—are really the only possible hope we have for meeting these power needs. After planning and negotiating for four years, INPCo claims that the community of Gussey's Gap now faces a simple choice: build the new plant and have a plentiful supply of energy or begin to accept the idea that energy will soon have to be rationed in the area.

The Buck Stops Here

Assume the role of a citizen of Gussey's Gap that will be familiar to you. For example, if your older brother is a construction worker, you might play the role of a construction worker. If your mother is a dental secretary, you could assume that role. From the perspective of the role you choose, decide whether you would favor or oppose construction of the power plant. Be prepared to defend your position with data and expert opinion.

Additional Questions

1. See if you can locate any information on the effects of thermal pollution on aquatic life. How complete is the knowledge we now have? What additional information is still needed?

2. What methods are used for cooling water before it is returned to a river or lake? How efficient are these methods? Can or should the efficiency of cooling be raised to 100 percent (the water cooled to the same temperature as when it was taken out)?

3. Suppose studies show that thermal pollution from the power plant described in this problem will result in a 10 percent decrease in aquatic life in the lake. To what extent and in what way would that bit of information affect your feeling about construction of the plant?

4. Suppose that you are absolutely opposed to the construction of this plant until thermal pollution can be guaranteed to be zero. How would you propose that the power company and/or the community deal with the energy crisis which seems likely to follow such an action?

5. The only way of solving the power-company/conservationist dilemma posed by thermal pollution, according to some observers, is to build nuclear power plants a few miles out into the ocean on large platforms over a virtually infinite supply of cooling water. What possible advantages and disadvantages would such a scheme have?

6. Some studies have shown that moderate warming of a lake or river may actually be beneficial to aquatic organisms. Explain how this might happen. How might this finding be related to the construction of nuclear power plants?

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Topic two The price of progress? Air pollution

Introduction

Dirty, smelly air has become a way of life for many Americans. Not long ago, one had to travel to Los Angeles, New York City, Chicago, or some other very large city to find out what smog is like. Today, almost every urban area in the country has its share of air pollution. One recent study showed that fouled air may be increasing even in rural areas, long thought to be the last refuge of a pure breath of air. And, even more important, every indication points to an increasing contamination of the nation's atmosphere. The production of every new electric can opener or garbage compactor is accompanied by another dose of industrial waste dumped into the air. The heating plant or air conditioner in each new housing unit slightly increases the nation's demand for energy and, consequently, the extra air pollution that invariably follows. The driver of each new car, bus, or truck is not only finding increased efficiency and comfort of transportation but also adding his or her own small share of carbon monoxide, nitrogen oxides, and other waste products to the air we all breathe. We want—and demand—growth and progress, but we pay for it in increasingly polluted atmosphere.

What are these wastes that make even walking down a city street a hazard? There are, first of all, particulates, tiny bits of solids like dust and soot. They account for much of the visual effect of air pollution: discolored houses and buildings, layers of dust on cars, and dirty clothing. They also contribute to human illness by clogging air sacs in our lungs. Another class of pollutants includes noxious gases like the sulfur and nitrogen oxides, hydrocarbons, and peroxides. These gases can be recognized most easily by the fact that they irritate the nose, throat, and eyes. The physical discomfort caused by smog, for example, can be traced to the presence of these compounds. They are undesirable, not only because they are unpleasant to breathe, however, but also because they can cause physical damage to living and nonliving materials. Sulfur dioxide, for example, can be oxidized in the air to sulfur trioxide, a compound which combines with water droplets also in the air to form sulfuric acid. A strong acid, sulfuric acid attacks limestone in buildings, iron in bridges, fiber in clothing, and a wide variety of other materials.

A third class of pollutants are those which have no odor, but are biologically dangerous. The most common of these is carbon monoxide. One could add carbon monoxide to perfectly pure air and never realize it was there because the gas has no taste, odor, or color. Yet, it may well be the most dangerous of all air pollutants since even in small doses it produces headaches, nausea, and other unpleasant effects. It can cause death in only slightly larger concentrations. Studies have shown that permissible levels of carbon monoxide are commonly exceeded during rush hour traffic jams in many large cities.

Who gets the credit for the contamination of our air supplies? By far the most important source of air pollutants is the combination of cars, planes, trucks, trains, ships, and other forms of transportation we use. Together, they produce 65.9 metric million of tons of wastes every year (1983 figures), of which nearly 72 percent is poisonous carbon monoxide. The combustion of fuels in gasoline-run motor vehicles is the single most serious threat to clean air, churning out more carbon monoxide (47.7 million tons per year) than *all* the wastes produced by any other single source of air pollution! The next most serious threat to the

air includes furnaces, ovens, and other stationary sources that burn coal, oil, gas, and wood for family or commercial purposes. These sources account for almost half the nitrogen oxides produced each year (9.7 million tons), 80 percent of all the sulfur oxides (16.8 million tons), and a total of 37.6 million tons of pollutants all together. The next most serious offender is industry, which accounts for 18.1 million tons of gaseous wastes in its various manufacturing processes each year. Iron and steel mills, petroleum refineries, and paper mills account for over ninety percent of all industrial air pollutants. The remaining gaseous wastes in the air come from a wide variety of sources: forest fires (accidental and intentional), garbage and solid waste incineration, agricultural burning, structural fires, and so on.

The effects of air pollution are widespread. From the simplest standpoint, pollutants are undesirable simply because they make everything so dirty and unattractive. Beyond that, they may actually attack buildings, bridges, and, in fact, almost any natural and many synthetic materials. Most important, of course, is the disease and injury pollutants can cause in plants and animals. Effects on humans range from simple eye and throat irritation to lowered resistance to disease, lung cancer, and emphysema, or even (in severe cases) death itself.

There just isn't much doubt about the harmful effects of air pollution, about the "villains" in the story, or about the kind of steps which must be taken to reduce pollution. Why, then, do we still have such severe problems with the atmosphere? Why don't we just go ahead and clean up our air? At first glance, the reason might seem to be inadequate technology. We may simply not have learned *how* to remove carbon monoxide from auto exhaust, nitrogen oxides from home furnace gases, and sulfur oxides from industrial smokestacks. The fact is, however, that insufficient technology may *not* be the most important factor. We probably know a good many more ways to reduce air pollution than we actually use. One large philanthropic foundation recently decided, in fact, not to approve any more grants for research on pollution abatement techniques since the field was already far more advanced than society had put to use!

No, lack of progress in fighting air pollution may be explained better by the unwillingness or inability of individuals and companies to apply the technology that's available. Very often, altering a manufacturing process or an industrial plant in order to reduce or eliminate pollution is a very expensive proposition. If the plant or process is only marginally profitable, the company may decide to close the plant rather than to modernize it. The decision to close plants rather than bring them up to standards can be especially crucial for small, one-industry towns. One estimate is that enforcement of present air pollution regulations would mean the loss of 50,000 to 100,000 jobs, and a severe economic crisis for fifty to 150 small towns. The desire for clean air does not, therefore, always lead to simple, straightforward methods for reducing pollution.

Case Study #1:
Cross-border pollution

"Good fences make good neighbors."

That line from Robert Frost may also be applied to pollution problems between two or more cities, states, or countries. One thing that has become clear in our studies of air and water pollution is that these problems are seldom restricted to specific, local geographic areas. The garbage that city A dumps into its water will eventually contaminate the city water supply of town B downstream. Town B, then, inherits the "pollution problems" of city A, whether it likes it or not! In fact, the "problem" of A's garbage may really be B's problem more than it is A's!

Similarly, the area most likely to suffer from smoke and other air pollution gushing forth from Detroit's auto plants is not Detroit itself, but its neighbor, Windsor, Canada, across the river and to the east of Detroit. The reason, of course, is that prevailing winds in southern Michigan are from the west, and they have a tendency to carry materials to the east and over Windsor. As auto production has increased, so have emissions from the plants. So, naturally, has the amount of pollution reaching Windsor.

From one standpoint, this kind of problem would seem to be simple and straightforward and relatively easy to solve. If factories in Detroit are dumping pollutants into the air, pollutants which foul the land and water in Windsor, then the solution is apparently simple: get factories in Detroit to cut down on their emissions. The issue is, of course, not really that simple, for increased problems for Windsor is a consequence of *improved* business conditions in Detroit. The better things are economically in Detroit, the worse Windsor's pollution problems become! Solving Windsor's *environmental* problems may mean making Detroit's *economic* situation less satisfactory.

Situations of this kind are appearing more and more often in the United States. Consider the case of the 1.1 million-kilowatt electrical generating plant at Mt. Storm, West Virginia. The plant is one of a new breed of "mine-mouth" generating plants which are being

built very near coal mines instead of near urban centers. In this way, not only is the expense of shipping coal reduced, but also (in theory, at least) air pollution caused by the plants is confined to less populated areas and, thus, is less of a problem.

That these "advantages" of mine-mouth plants do not always work out in practice exactly as planned is illustrated by the Mt. Storm plant. To be sure, the new installation has been an enormous boon to the town of Mt. Storm itself. Previously, a pocket of unemployment, the area now booms with jobs. Workers are well-paid by the power company, land values are up, and the general economic situation in Grant County (where Mt. Storm is located) is the best in years.

As you might expect, a good deal of inconvenience and discomfort have become part of the daily life in Mt. Storm. Residents find that a fine, black, oily film now covers everything left out-of-doors. And many citizens spend as little time out of the house as possible. But for most, these inconveniences are a small price to pay for the new economic security offered by the plant, and they speak loudly in praise of it.

Not everyone is as delighted with the plant as are the residents of Mt. Storm, however. Only ten miles away, across the Potomac River in Maryland, Christmas tree farmers in Gorman have begun to complain bitterly about the plant. Ever since the plant opened, its smokestacks have been spewing sixty tons of fly ash and twenty tons of sulfur dioxide into the air each day. At the same time, the quality of Gorman's evergreen trees has declined. Some growers report that their crops dropped from tens of thousands of high quality trees to only a few thousand second-rate trees in only three years. In some cases, there have been *no* marketable trees at all. Studies by specialists from a nearby state college have confirmed what the farmers had already suspected: sulfur dioxide fumes from the Mt. Storm plant are slowly killing all the young Christmas trees.

Power company officials are fighting back. Their own expert witnesses insist the trees are falling victim to insect pests. They admit that smoke and gases from the chimneys are still more than they should be. Even the installation of $7.5 million worth of air pollution control equipment didn't work as well as expected. But the investment of another $13 million in additional equipment should reduce emissions to an "acceptable" level, they claim.

Pollutants released by a factory in one state often travel less than a mile before they begin to affect the environment in a second state. What governmental, private, or industrial group has the responsibility for problems of this kind? (photo courtesy of the Environmental Protection Agency)

The Buck Stops Here

Since this issue involves more than a single state, the federal government has become involved. You have

been chosen as a mediator to resolve the dispute. List as many possible solutions as you can think of for this problem. When your list is as complete as you can make it, eliminate those suggestions which you think will not work and give the scientific, political, economic, or other reason why you think they will be unsatisfactory. You may want to call in other class members as "expert witnesses" on one or more aspects of the question. Finally, prepare a recommendation that outlines the procedure by which this issue can most effectively be resolved.

Additional Questions

1. Do you think that an *international* dispute would be easier or more difficult to resolve than an inter-state argument like this one? Explain.

2. One observer in the situation described here was said to remark that "The state of Maryland cares more about its Christmas trees than the state of West Virginia does about its people!" In what respects might that statement be true? In what respects might it be false or unfair?

3. Find out how *your* community is threatened by pollution (air, water, or other) from another city or state. What action can the citizens of your town take to protect themselves against these threats?

4. If you were a citizen of Mt. Storm, what *specific* reasons might you have for supporting the power company in the operation of its plant? Would there by *any* reason that a resident of Gorman would defend the plant's operation?

5. See what you can learn about "mine-mouth" power plants. What is the purpose behind their construction? How well are they working out?

6. One reason that this problem has arisen is the enormous demand for electrical energy in recent years. If this energy cannot come from plants like the one at Mt. Storm, where *will* it come from? Would problems of cross-border pollution be eliminated or alleviated by the alternatives you suggest? Why or why not?

Case Study #2: How much is the title "Clean Air Capital" worth?

The article reprinted below illustrates the real dilemma faced by many small towns today. The citizens of Escanaba obviously feel pride in the clean, healthy environment they have long enjoyed. But they cannot survive on pride; they must work and eat. In their case, that might mean having to sacrifice some of the natural charm—and, perhaps, accept some health risks—to maintain an acceptable standard of living. What should they do?

*How much is "Clean Air Capital" title worth?**

RALPH TRUAX

Escanaba—This pretty and prosperous Upper Peninsula city of 15,400 only a year and a half ago earned the title of "Clean Air Capital of the United States." Yet today Escanaba is beset on all sides by air pollution and the possibility of further pollution in the form of a horrendous stink.

The burning problem for this city's citizens first arose when the Mead Corp. of Dayton, Ohio, recently announced its intention to build a huge kraft paper processing plant here as phase two of a three-step industrial program to make Escanaba the largest supplier of quality publishing papers in the nation.

What has caused doubt in the minds of this community's citizens is that all kraft paper mills now operating in this country stink. That is literally the word for the "rotten eggs" smell emitted by kraft mills using the sodium sulfate process, which gives off in its various operational processes an effluvium of hydrogen sulfide.

The problem is not one which seems subject to easy solutions. Mead is a respected and established member of the Escanaba business community.

*From the Grand Rapids (Michigan) *Press*, November 16, 1969. Reprinted by permission.

having had an investment in the Escanaba Paper Co. since 1919 and having owned a controlling interest in the company since 1942. The plant here is now a division of Mead Corp.

Much at stake

As Mead officials say, "We would do nothing to injure this community." And they point out that they have as much at stake in Escanaba and Delta County as the next man—in fact, maybe more than most.

What bothers residents is that there always remains, even under optimum conditions, the possibility of odor from a mill using the sulfate process for taking the lignin, the binder which holds wood fibers together, out of the wood so as to render the fibers fit for paper making.

The majority of kraft paper, once associated with heavy, strong shopping bags, now goes to the publishing industry as bleached and coated quality papers suitable for high grade pictorial and typographical reproduction for magazines.

The kraft process is one most suited to Upper Peninsula operation as it can make use of all species of wood. The UP produces a variety of pulp woods, both deciduous and coniferous.

The announcement last April 28 that Mead was ready to start phase two of its program and had authorized expenditures of more than $50 million for the kraft mill and equipment brought cries of joy from some sectors of the Escanaba business community and equally loud cries of anguish from some of the populace.

John T. Walbridge, owner and president of American Timber Homes, Inc. of Escanaba, immediately queried Mead officials as to the possibility of smells emanating from the proposed kraft plant and was informed that no guarantees could be made that the plant at some time would not give off obnoxious odors. They, of course, assured Walbridge that everything possible would be done to prevent this.

Despite the assurances of the company, Walbridge thought of the Fox River Valley in Wisconsin. Some persons described this kraft paper-making area as one continuous stink from Neenah and Menasha to Green Bay.

Mead informed Walbridge that a new virtually odor-free mill had recently been constructed at Wisconsin Rapids, Wis. by the Consolidated Paper Co. and invited him to go there and do some smelling on his own. Walbridge did just that and found that the mill did indeed smell. He and his wife Mary Lou knocked on many doors and found out that the obnoxious odors produced by the mill were about as bad as any the residents had ever smelled.

Early last May, Walbridge and several other interested persons formed a Delta County Citizens Committee to Save Our Air. The group elected Amer Pederson president and began drumming up citizen interest in opposition to the stink they fully expect the kraft plant to make.

The committee and those who fear the Mead expansion believe that an obnoxious odor would mean the end of industrial expansion in the area and would most certainly ring down the curtain on the burgeoning tourist business. Among those most fearful of the expansion are retired persons who have settled in expensive residences along the west shore of beautiful Little Bay De Noc.

Kraft mill odors not only affect the immediate area but have been known to be unpleasant up to 60 miles. What makes kraft mills so feared by a populace and so obnoxious to the nose is that hydrogen sulfide can be detected in air dilutions as low as five parts per billion. The gas has a noxious

quality, and it is claimed that plants and even trees are killed in the path of the gaseous emission. Hydrogen sulfide also reacts on the lead in paint and often blackens painted houses.

The Escanaba Paper Co. officials state publicly they feel this fear on the part of citizens is an honest concern but they point out that never before has a mill been built utilizing all of the goodies of modern paper-mill construction at one time. But, they say, that is what is planned for Escanaba.

Henry Caldwell, Mead engineer in charge of planning for the new mill, says that everything will be done to eliminate odor. The latest scrubbers will be engineered in and the furnace which recovers the chemicals for reuse will be of the latest design. Water pollution will be at an absolutely nonharmful level, they promise.

Visited Sweden

Mead officials even visted Sweden to check the latest in odor-free mills there and came back with a report that there was no odor.

One sticky point remains: The company cannot give an iron-clad guarantee that the mill will not emit odors during periods of unusual weather or at times of breakdown of certain phases of operation. The committee has proposed alternate paper-making processes which are odor free, but they have been rejected as too experimental or too costly.

The Save Our Air Committee has gone ahead and drawn up an air pollution control ordinance for Delta County which has been presented to the board of supervisors and which defines air contaminants and pollution and which sets up a citizens board to act on matters of control at the local level.

As one person put it, "They can't smell our kraft plant from Lansing, but if we can here we want to be able to do something about it."

As matters now stand, opposition to the mill seems to be growing. At a general meeting in mid-September an overflow crowd of more than 400 persons attended a general meeting applauding warmly the committee's efforts. The ordinance is now under advisement by the supervisors, who, according to Walbridge, seem by their actions to be hostile to the clean air committee and the ordinance. He points out that two of them are Mead employees.

Money easy to raise

Money seems rather easy to raise for committee promotions, says Walbridge, who has had some experience in this field as one-time county Republican party chairman. The committee has endorsements from both the GOP and the Democrats along with labor groups.

What has stirred interest to a high pitch have been several occurrences since the clean air controversy began.

A serious dust problem has arisen as a result of operations and stockpiling of iron ore pellets at the Chicago & Northwestern Railway's ore docks in the northern section of town on the bay shore. A meeting last Tuesday night drew an irate crowd of more than 100 persons who aired their complaints before the Save Our Air Committee.

One man claimed that the jar from the railroad ore cars jamming together and loading and unloading day and night had cracked walls of his home and that dust lay thick over the entire area. A car dealer blocks away from the docks has complained that the cost of keeping his cars washed has now reached many thousands of dollars since the docks have been in operation less than a year.

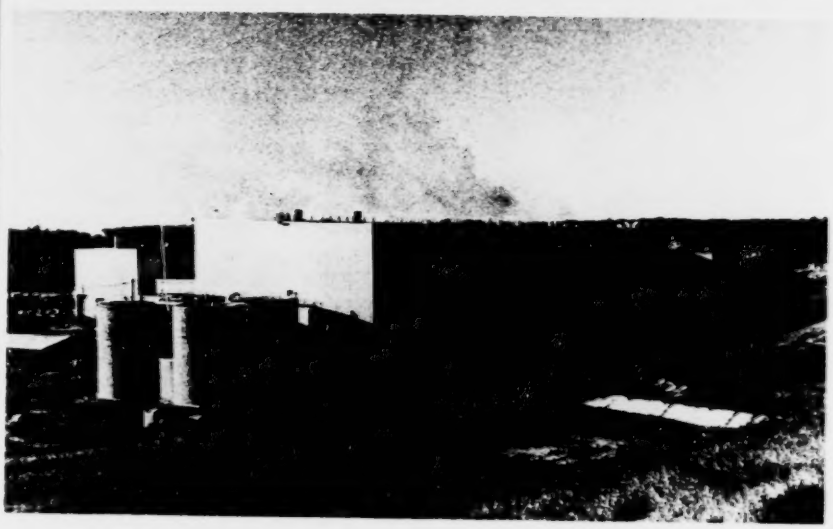
Escanaba is in a peculiar position in regard to the docks as it underwrote the bonding issue which financed the building of the docks for C&NW.

The city is also under orders by the Michigan Department of Public

Health to halt air pollution from its asphalt plant west of town. Many citizens have complained to the health department. Operation of the plant has been shut down until spring, but the city will have to face the problem in earnest at that time.

Only recently did the Mead Corp. install more than $2 million worth of equipment to clean up and prevent further pollution of the Escanaba River. The company had been under orders by the state Water Resources Commission and the cleanup mechanics have been in operation only about a month. The river is much improved and the cleanup mechanics have improved and hopefully time will solve the remainder of the problem.

In addition to its other problems, Escanaba must come up with $6.5 million in the near future for a sewage disposal facility.



What additional information do these two photos provide you about the case study on air pollution in Escanaba? In what specific ways do you think either or both of these photographs will be different if the new Mead plant is approved? (photo courtesy of Ralph Truax, Grand Rapids PRESS)

Since the day in May of 1968 when Atmospherics, Inc., of Fresno, California, sampled the air at 5,000 feet above Escanaba for a study by the Atmospheric Research Center of the State University of New York and proclaimed, "No place has as few particles in the air as this area," things have not been the same in this community.

What makes it difficult is the ambivalence of the situation. No one is against clean air and the remote chance that the Mead plant will pollute it has caused soul-searching and suffering among the citizenry.

Expansion halted

A planned $2.7 million motel expansion and convention center has been postponed until such time as the county clean air ordinance is adopted or the Mead plant is in operation, and the motel management can smell for itself whether the mill is actually odor-free.

Mead's position is, of course, that it can and will build an odorless pulp plant and that the eventual economic advantages to the Upper Peninsula and the city will be manifold.

Mead must still get a permit from the Air Pollution Control Commission to build the mill; such approval it is assumed would hinge on the company's ability to convince the commission it can build an odor-free plant.

Next to Harnischfeder Corp., manufacturer of heavy excavating equipment, which employs about 1,400, Mead is the second largest employer in the area. Some 820 persons work at the paper mill; and the kraft plant, which Mead hopes to begin building in early 1970, will provide about 50 more jobs as well as upgrading about 100 more. When the whole project is finished, which will include another monster paper-making machine in phase three, another 200 inplant jobs will be added and about 350 more in the woods in forest management and by independent logging companies supplying the mill.

In full operation

Mead points out the $56.6 million plant addition finished last month and now in full operation as evidence of its willingness to invest huge sums and its faith in the community.

The plant is using 35,000 cords of wood and chips now per year and the plant, when completed in all its phases, would use 10 times that amount. The giant new machine can make 120,000 tons of paper a year and run it out in 25-foot widths. By the grinding process the mill now produces about 100 tons a day. The new kraft mill could produce at least 600 tons a day and another 50 tons could be added to existing ground pulping facilities, say company officials.

Mead paints a rosy picture of progress. The company owns 373,000 acres of commercial forest which stretches nearly across the Upper Peninsula.

"Our interests transcend pulping operations," says Jean Worth, community relations officer for Mead and, until he retired recently, editor of the Escanaba Press. "The company hopes to grow a great commercial forest which can bring untold wealth to the UP." Wood is the peninsula's No. 1 natural resource and the only one which can be renewed.

On the one hand Mead's expansion can mean an eventual total of 1,000 jobs and great economic advancement for an area so badly in need of it. On the other hand, it is possible the fears are justified and the kraft mill will be malodorous. This could undo all the good, clean air advocates feel. It will take a great deal of patience, soul-searching and trust on both sides to resolve the issue.

The Buck Stops Here

You live in the town of Escanaba. Select a role to play (mayor, homemaker, merchant, bank president, schoolteacher, or another role of your choosing) and decide how *you* feel about the prospects of a new paper plant in town. Then meet with other members of the class and, from the perspective of the roles you've chosen, decide what *joint* action would be appropriate (if any) for your group to take. You may consider legal, political, educational, persuasive, or any other form of action.

Additional Questions

1. What methods are currently available for reducing air pollutants from a factory? List as many as you can find. Then report in detail about any one. Your report should explain how the method works, for what pollutants it is effective, its advantages and disadvantages, the extent to which it is now used, etc.

2. The city council decides that Mead's new paper mill must eliminate 90 percent of the pollutants it produces. Mead refuses to agree to this condition and threatens to close the mill completely. Is the council's decision fair? Is Mead's response "blackmail"? Explain your answer to each question.

3. The *Press* article stresses the purity of Escanaba's air. Suppose that the town had to live with a smoggier, smellier environment. Would that be simply an aesthetic problem? Why or why not?

4. You, personally, have decided that you really want to live in a community (like Escanaba) where air, water, and land are as pure, clean, and healthful as they were 200 years ago. Is this a reasonable expectation? Describe the kind of community this would be. Explain how people would survive economically ("making a living") in such a community. If you think this is an unlikely dream, explain why.

5. At the point this article was written, the debate was primarily between the citizens of a small town (Escanaba) and Mead Paper Company. Why and under what circumstances, might other institutions, agencies, or organizations (e.g., state or federal government, labor unions) become involved in this issue? *Should* they? Why or why not?

6. Imagine that you are a high school senior or college freshman living in Escanaba. How, if at all, might you become involved in the above problem? Should people in the sixteen to twenty-one age group be concerned with questions like this? Should they be expected to help solve them? *Are* they? Explain your answer to each question.

Case Study #3: Acid rain

Concern about contamination of our atmosphere has taken a new direction recently. Since the late 1970s, the issue of acid rain has received growing attention. What does the term "acid rain" mean? Water that falls to the earth as rain is often thought of as "absolutely pure." This isn't quite true. As water droplets fall, they dissolve various solids, liquids, and gases found in the air. Carbon dioxide, for example, is a normal component of the air that is fairly soluble in water. Rainwater often dissolves measurable amounts of carbon dioxide as it falls to the ground.

The substances absorbed by rainwater from pure, clean air do not contaminate it in any appreciable way. Carbon dioxide dissolved in water does it no harm. In fact, carbon dioxide improves the flavor of drinking water. Problems arise, however, when rain falls through an atmosphere which contains less harmless pollutants, such as those produced by home heating systems, industrial factories, and power-generating plants. Among other things, these pollutants include nitrogen and sulfur oxides, formed during the combustion of coal. When dissolved by raindrops, these oxides react with water and form nitric and sulfuric acids.

As with most pollution problems, relatively small concentrations of these acids in rainwater create modest problems—but no more—for the environment. The growth of some organisms may actually be promoted by a mildly acidic condition. The difficulty arises when the level of nitrogen and sulfur oxides in the air increases dramatically. And this is just what is happening as our nation switches from the use of natural gas and petroleum to coal as a source of power.

From the early 1950s to the late 1970s, gas and oil were the fuels most widely used in commercial, industrial, and power-generating plants. Increasing shortages and higher prices for these fuels have made it necessary for many of these plants to shift over to coal as a source of energy. As this change accelerated, the concentrations of nitrogen and sulfur oxides produced during the combustion of coal (a problem of minor concern with gas and oil) began to rise.

Simultaneously, the acid concentrations of rainfalls also began to increase.

Following a familiar pattern once more, it was usually not the geographical area in which nitrogen and sulfur oxides were *produced* that experienced the effects of acid rains. It was (and is) the areas far beyond them. The reason for this is easy to understand. Nitrogen and sulfur oxides released from smokestacks are carried high into the atmosphere, then dispersed over the countryside (usually eastward) by prevailing winds. They continue drifting from their point of origin until a rainfall washes them out of the air and onto the ground.

Studies carried out in the early 1980s showed rainfalls in parts of North America and Western Europe to be as acidic as lemon juice or vinegar and, in some cases, as acidic as battery acid!

Needless to say, rainwater of this acidity is not very healthy for an environment. Aquatic plants and animals can not survive large changes in acidity, and increases in acid rain have meant extinction for large populations of water plants, insects, frogs, salamanders, and freshwater fish. Indeed, even some forms of rocks, like limestone and marble, are dissolved by acid rain.

The solution to acid rain problems is not a simple one. As power plants in Canada and the American Midwest change over to coal-fired systems, lakes in New England and Canada sicken and die at an accelerating rate. Like the issues of cross-border pollution discussed above, problems of acid rain have become interstate and international in their scope and can be resolved only by the interaction of many governmental and private agencies.

The Buck Stops Here

You have owned a cottage on Lake Shiawanassee in Eastern Canada for ten years. Over the past two summers, you and other summer residents are becoming increasingly concerned about the condition of the lake. The wilderness area you know and love appears to be changing. These changes are neither sudden nor dramatic. But for Canadians and Americans alike who have made the lake their vacation home for many years, the indications are becoming hard to ignore. Fish are dying more rapidly than you can remember, and the lake itself has taken on that beautiful silvery sheen which, despite its beauty, is a sign of high acidity. A neighbor reports to you that a local chemist has measured the pH of the lake as 5.5. You and she decide that "something has to be done" to save the lake. What is that "something"? Meet with other students working on this case as a committee to save the Shiawanassee. Decide what you can and should do to prevent further damage to the lake.

Additional Questions

1. The acidity of a substance is measured by its "pH." The pH of most substances falls between 1 and 14. Find out what the pH of the following substances is: pure water, lemon juice, household ammonia, vinegar, commercial hydrochloric acid, household lye, milk of magnesia, stomach acid. At what pH does a substance become dangerous to aquatic organisms? To human health?

2. In what respects is the United States responsible for the destruction of lakes in Eastern Canada? Who (government, industry, private individuals) is/are responsible? What should each of these three groups be expected *to do* about this problem?

3. What arguments could you make, as a Canadian, for the position that acid rain in Canada is a *good* thing?

4. Is there really any reason that a citizen of the United States should be concerned *at all* about acid rain in Canada? Why or why not?

5. "Chances are that the conditions that brought about acid rains in the first place—increased industrialization—are not going to go away. In fact, the pressures for more of the same are probably quite great. An improved economic situation is almost inevitably tied with increased levels of acid rain." What reactions do you have to this line of reasoning?

6. Lake Nakawana is about ten kilometers (6.2 miles) distant from Lake Shiawanassee. In nearly all respects, the lakes are identical. The major difference is that about 200 people have homes on Lake Shiawanassee while the Lake Nakawana region is totally uninhabited. What difference should this make, if any, in the attempts to solve the acid rain problem at each lake? Explain your answer.

7. A bill recently introduced in the United States Senate attempts to deal with the problems of acid rain in the United States and Canada. It requires industrial plants to limit the amount of nitrogen and sulfur oxides to their 1982 levels. Then, it requires industries to *reduce*

these emissions by an average of one percent per year over the next twenty years.

a. To what extent would this bill help solve the problems at Lake Shiawanassee? Of acid rain, in general?

b. What chances do you think this bill has of passing? Explain your answer.

c. Do *you* favor or oppose this bill? Explain your answer.

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Topic three
No place left to throw things away: Solid waste disposal

Introduction

If there is any single measure of our "success" as a modern industrial nation, it is an ecological problem unique in the life of this planet—the abundance of solid wastes. Most of us who are accustomed to throwing empty soda cans out the car window, dropping a crumpled cigarette pack on the sidewalk, or leaving an enormous pile of garbage at our curbside probably don't realize that we're exercising a right that has been available to few men and women in history—the right to throw things away! Not that there hasn't always been litter, for there certainly has been. But never of the magnitude we have in America today. People have usually been too poor to afford discarding wastes. Everything that could be recycled in the past, was.

Today our problem is twofold. First, we are rich enough as a nation to throw things away when we're done with them rather than saving and reusing them. Most aluminum cans used for beer, soft drinks, or other purposes are simply tossed into the trash. Usually, they end up in a garbage dump, buried under the earth as landfill, at the bottom of a lake, or in some other place where the aluminum from which they're made can never be recovered. The assumption behind this practice is that we have an unlimited supply of aluminum, which is not true, as we're just beginning to realize.

A second consideration is the *kind* of materials which end up in the trash heap. Before we became so advanced technologically, most of the materials we used were essentially natural materials. Boats, for example, were built of wood. When the boat sank, fell apart, or just grew so old that it had to be junked, nature knew how to take care of the wastes. All kinds of organisms, from bacteria to termites, went to work on the wood from which the boat was made and began to convert it to organic materials which blended back into the natural environment. A contemporary boat made of fiberglass or some other plastic material presents a different challenge. The materials (like fiberglass) produced by chemical research don't exist in nature, so there just aren't any bacteria around that know how to break them down. A discarded wooden boat begins to return to the soil after a few years; a fiberglass boat is here essentially forever!

What are the sources of all this garbage? We really have only to look around to get some clear idea of the answer to that question: plastic wrappings, containers, molds, packing, bottles, and the like; glass bottles and containers; waste paper bags and wrappings, newspapers and magazines, forms, and a host of new applications of paper, like throwaway clothing; garbage from private homes, restaurants, and institutions; grass clippings, dead limbs, and leaves; "dead" cars, trucks, buses, machinery and tools; and so on.

We may be less familiar with the by-products of mining and smelting operations. Getting an ore out of the ground and converting it to a metal produces huge mountains of waste. In extreme cases, a whole metric ton of earth may produce no more than a few kilograms (pounds) of pure metal. The remaining 995 kilograms (2,190 pounds) or so of earth become waste to be disposed of somewhere. Agricultural wastes have become an important factor in the problem for two reasons. First, modern agricultural practice often isolates livestock in high confined areas (like feedlots or "chicken factories"). Instead of spreading animal wastes over a large field, where they could be more easily absorbed at considerable benefit to the soil, this practice concentrates wastes in a small area, and disposal becomes a severe problem. Pre-World War II

conservation practices of using animal wastes to fertilize crops can now be continued only at great inconvenience and expense. The third case study below gives you a chance to think in more detail about this issue.

A somewhat different kind of solid waste problem is that of nuclear waste disposal. The difficulty here is not so much one of volume as of persistence and danger. The growing importance of nuclear power reactors means that we can expect increased quantities of spent nuclear fuels to be disposed of each year. Even though we are speaking of only a few hundreds or thousands of pounds of fuel each year, the task presents special difficulties. Most of these materials are radioactive and will continue to be so for decades or centuries. Disposing of them in traditional ways, by dumping in the ocean, for example, is completely unacceptable since the radioactive materials could so easily get into public air, water, and food supplies. The second case study below deals with this aspect of our solid waste problem.

The most recent variation on the waste disposal issue concerns hazardous chemicals. Industries today use and produce thousands of different chemicals in manufacturing processes. What is to be done with the enormous volume of chemical wastes produced by industries each year?

This problem is fairly new for two reasons. First the diversity and volume of waste chemicals has increased dramatically in recent years. Second, and more important, we are learning a great deal more about the dangers of many chemicals. Many waste substances that were buried, dumped into rivers and lakes, or burned in the past have been shown to be toxic, carcinogenic, or teratogenic. The Love Canal incident in the late 1970s was a shocking warning of the dangers posed by hazardous chemical wastes. The United States at the start of the 1980s found itself a nation with surprisingly large volumes of potentially dangerous chemicals . . . with no place to put them. The fourth case study in this topic concerns the disposal of hazardous chemical wastes.

How then to deal with all the junk we produce each day? Twenty years ago, of course, that just wasn't a problem. We dumped it into rivers, lakes, and open garbage dumps. Sheer volume alone makes that solution unsatisfactory today. Municipal garbage dumps all over the country are filling up or already have filled up. San Francisco, in a crisis that is becoming common in urban areas, ran out of disposal areas some years ago. The city attempted to contract with the Western Pacific Railroad to haul its refuse 375 miles to Lassen County near the Nevada border. When the plan failed, the city resorted to dumping its wastes into one of the world's great natural harbors, San Francisco Bay. Horror stories like this are becoming familiar among those people involved with the problems of running large municipal governments.

More sophisticated approaches to the problem are not always satisfactory either. Municipal incinerators where trash is burned are usually undesirable because of the air pollution they produce. The combustion of certain plastics, for example, produces noxious or corrosive fumes, like hydrogen chloride, from which

What method is being used for the disposal of radioactive wastes here? How effective has this method been? What are some additional ways of disposing of nuclear wastes? How effective is each? (photo courtesy of U.S. Energy Research and Development Administration)

hydrochloric acid is formed. Some critics claim that the fumes from the incinerator in Washington, D.C., produce measurable air pollution in Bangor, Maine, more than 500 miles away!

Landfill is an appealing alternative. The idea is to find some unused area into which refuse can be dumped. The trash is then covered over with clean, fertile dirt so that parks, housing projects, or other new facilities can be developed on the land. But certain difficulties arise with this procedure too, not the least of which is that the space needed for landfill projects is simply not available in many urban areas.

Ideally, of course, we should do a good deal more recycling of our wastes. Paper, glass, and metal can all be reprocessed so that the materials, once used, will not be lost forever. A number of experimental projects, many in Europe, have been designed to find economical ways to reuse the things we normally throw away. One common technique is to separate organic matter from reusable materials like glass and metal, and then convert it (the organic material) into fertilizer, which can then be sold. Another suggestion has been to find ways of converting garbage into petroleum, thereby "killing two birds (waste disposal and energy shortage) with one stone." A process for making this conversion has been tested successfully on a small scale, but the yield (one barrel of oil from one ton of garbage) is too small to be economical at this point.

Case Study #1: Save or pay

For the present, the most promising solution to the problem of waste disposal seems to be recycling. When paper, glass, metal and other materials are collected and reused, at least two advantages result: (1) valuable (and in some cases, increasingly scarce) substances are conserved, and (2) solid wastes are reduced in volume. Getting people to participate in recycling problems may be difficult to do, however. For years, business and industry have been trying to convince us of the pleasures and benefits of no-deposit, no-return cans, bottles, and other containers. It may now be hard to change consumers' minds *back* to the belief in reusing these materials.

Some early efforts at promoting recycling were, in fact, dismal failures. People were just too busy, too lazy, or too uncaring to flatten cans and tie up papers for recycling drives. This presents a dilemma which comes up over and over again in dealing with environmental and ecological problems. What happens when people will not *voluntarily* take part in efforts that are necessary to solve crucial social problems? The answer which is sometimes given, and which some people say is the only possible answer, is to write legislation that *forces* people to do what they should or must do.

Let us say that a certain state legislature is presently considering a bill which would do just that in the case of waste disposal. The bill contains two major sections. Part One would levy a 20 percent surcharge on the purchase price of certain objects (to be named later) whose disposal contributes most to the current waste problem. For example, a consumer who buys milk in a glass container would have to pay the regular price of the milk plus a 20 percent deposit for the bottle. When the bottle was returned to the store, the surcharge would be returned or credited toward the next bottle of milk purchased. Similarly, instead of paying forty cents for a soft drink at a vending machine, you would have to pay fifty cents (forty cents purchase price plus ten cents toward the surcharge). The extra dime could be gotten back later by returning the can to a local recycling center. Even large objects, like washing machines, television sets, and automobiles, would be included under the plan. The cost of a new car, for instance, might be as much as $2,000 more, but this "deposit" would be collectible when the car was traded in for a new one or sold for junk at a registered junkyard.

The second part of the bill would impose stiff fines for anyone caught littering. A person seen throwing a gum wrapper out of a car window, and found guilty of that offense, for example, would be subject to an *automatic* fine of $100. The fine would always be automatic upon conviction, and the amount would never be less than $100, but could be much higher at the judge's discretion. Anyone found guilty of leaving an old, broken-down car in some back alley, for instance, would not only lose his initial 20 percent deposit on the car, but could also be fined an additional $1,000 or more.

The Buck Stops Here

Assume the role of a research assistant working for a representative in this state legislature. Prepare an outline that details the strong and weak points of this bill. Then decide whether your representative should vote for or against the bill. Be prepared to defend your decisions against those on the other side of the argument.

Additional Questions

1. What arguments do you think could be made *for* and *against* this bill? From the standpoint of the consumer, would you tend to favor or oppose the bill? From the standpoint of a stockholder in a large corporation, what would be your opinion? From the standpoint of a local

governmental official, what would be your judgment?

2. The bill addresses itself almost exclusively to the activities of the consumer. That is, the responsibility for improving the problem of too many wastes is placed entirely in the hands of the private citizen. To what extent should that responsibility be "passed around" to other segments of society? Who else in the society should be expected to assist in solving this problem? What kinds of contributions should, for example, business, advertising, industry, and government be expected to make? You might try writing amendments to the bill which would contain your feelings about this aspect of the problem.

3. Proposals like the one outlined in this bill are sometimes placed on the ballot in a general election. This allows the public to express its viewpoint on the question. In such cases, certain industries may spend enormous amounts of money to defeat the proposal. Those in favor of the bill seldom have the financial resources available to industry. What difference does all this make in terms of whether or not the bill passes? What should be done, if anything, to equalize the money spent by both sides in an election like this?

4. See what you can find out about attempts which have been and are being made to salvage materials from junk heaps. What processes have been developed for recycling paper? Glass? Metal? What are the apparent advantages and disadvantages in these processes?

5. "Bottle bills" have been passed in a few states during the last few years. Find out what the provisions of such bills have been. Have they worked? Why or why not?

6. Recently there seems to be a good deal more research on this problem in countries other than the United States. Why might this be true? Is this a matter about which we should be concerned?

7. Suppose that you oppose the approach toward solving the waste problems described in this bill. What alternative suggestions do you have for solving the problem?

8. One proposal for reducing the waste disposal problem is to transport garbage, trash and other refuse to coastal areas, dump it into the water, and construct new land areas on which homes could be built. This would be an exciting way of producing the kind of ocean-front living that so many people seem to desire. What reactions would you have to this proposal?

Case Study #2: Nuclear wastes

Rep. Watson Vixen was a shoe salesman before his election to the House of Representatives twenty-four years ago. Today, he is chairman of the House Subcommittee on Nuclear Energy. Rep. Vixen has listened to expert testimony on the problems of nuclear power plant construction for over a decade. At this point, he is convinced that the issue of waste disposal is the major roadblock in the expansion of nuclear power. "Congress can pass all the laws we want to make licensing of nuclear plants easier," he has said, "but the disposal of nuclear wastes is not a legislative question. Until scientists find a way of getting rid of 'nuclear garbage,' the nuclear power industry will be stalled."

The solution to this dilemma, Rep. Vixen now believes, is to fire nuclear wastes into space on sun-orbiting rockets. Although this may seem like an expensive plan, it should be feasible for two important reasons. First, there simply are no alternative methods of waste disposal available. Every other system devised has some major flaw(s) which make it impossible to use. Second, the cost of orbiting nuclear wastes is admittedly high: about one million dollars for each kilogram (2.2 pounds) of waste. But the total amount of waste to be disposed of is relatively small. It is the intensity of the waste, not the amount, which concerns us.

For the reasons outlined here, Rep. Vixen has introduced into the House a bill that will require all producers of nuclear wastes to ship these wastes to a launch site in Florida, where they will be shot into space once every three months. The cost of this venture is to be split evenly between the federal government and the waste-producing industry.

The Buck Stops Here

As a member of the House Subcommittee on Nuclear Energy, you will be expected to find out about, consider, decide, and vote on Rep. Vixen's proposal. You need to concentrate on the two main features of his argument (points 1 and 2 above). Find out first if the argument in 2 is really true, and then what the *total cost* of this program would be for the current fiscal year. Complete data will be difficult to find, but you

should be able to make a reasonable estimate. When you have completed your background research, prepare a brief statement that explains the position you would take on Rep. Vixen's bill.

Additional Questions

1. Rep. Vixen's prelegislative career obviously did not prepare him for his present position of responsibility. By what mechanism is he now able to get the kind of information and advice he needs to make the kind of decisions illustrated here?

2. Is this (your answer to Question 1) the way government *ought* to operate? Should decisions on scientific questions be made by government officials or by scientists?

3. The United States has been producing nuclear wastes for over thirty years. What has been done with those wastes so far? Is the disposal system satisfactory or unsatisfactory? If the former, why is nuclear waste disposal a problem *now*? If the latter, what has been and is being done about unsatisfactory systems of waste disposal?

4. As county chair of the committee to stop nuclear power, list the specific problems posed by nuclear wastes.

5. As scientific consultant to the Gem-Eye Nuclear Power Plant, list the specific methods now available for nuclear waste disposal, and then describe the advantages and disadvantages of each.

6. At the present time, Honduras produces no nuclear wastes of its own. What objections might a citizen of Honduras have to Rep. Vixen's plan? To any of the other methods listed in Question 5?

7. Rep. Vixen's bill calls for industry and government to split the costs of his nuclear waste disposal plan. Does this seem proper to you? Why or why not?

8. Resolved: Since no economical methods for nuclear waste disposal have been developed as of the present, no new nuclear power plants should be authorized until an acceptable system *is* devised. Argue either *for* or *against* this proposition.

Case Study #3: Feedlot wastes

After almost 100 years operating the B-Bar-B ranch, the Austin family has decided to convert its operation totally to a feedlot system. About 100,000 head of cattle are involved. Feedlots were introduced to American agriculture in the early 1950s. Now, only three decades later, there are over a quarter million such installations for cattle alone in this country. The advantages of feedlots are impressive. Rather than having cattle off looking for food on open ranges, the cattle remain in one place while food is brought to them. This system requires only about 200 square feet for each steer, compared to the almost 90,000 square feet he would need on a ranch. The Austins have learned that feedlots not only make feeding simpler, but also make it possible for owners to control their animals' living environment very precisely. In this way, they can provide exactly the conditions most necessary for rapid, efficient growth.

The problem associated with feedlots, however, is what to do with the animal wastes that are produced. When cattle roam loose on the range, there is no difficulty. Their wastes are distributed over a wide area. In feedlots, the manure is concentrated in a relatively small space. Furthermore, there isn't any simple way to get rid of the wastes. When cattle are kept by farmers, manure is a valuable fertilizer that can be used on crops. Most feedlots, however, are located near cities (the Austins' will be just outside Dallas) to reduce transportation costs. It is seldom economical to ship the manure back to the farmers for use as a fertilizer.

The most serious aspect of the whole story may be the pollution of water supplies by animal waste. If manure is not removed, it is washed into rivers, lakes, and streams that make up public water supplies. Something must obviously be done, if water supplies near feedlots are not to be contaminated. Recognizing this problem, the Austins have hired a member of the economics department at Southwestern Military Institute to do a study of waste disposal in their new feedlot. The study suggests some ways in which wastes might be dealt with, and the advantages and disadvantages of each alternative. Here is a list of alternatives suggested by the expert:

System	A Advantage	B Disadvantage
Sold to farmers as fertilizer	Wastes are removed	Expensive to ship
Burying	Complete disposal	Expensive
Burning		
Treat wastes with bacteria		
Drying and removal or burning		Requires large areas of land
Establishing a commercial manure processing plant as an adjunct to the feedlot	Wastes are recycled and sold to produce income	Possibly expensive to ship, but less so dried and bagged, and with a greater market

The Buck Stops Here

Select either of the following roles:

1. You are the economics expert hired by the Austins. Complete Column A of the table above. Try to find at least two advantages for each method listed. Then select the system for waste removal that you think will be best for the Austins; OR

2. You are the county health officer and must approve the method chosen by the Austins. Complete Column B of the table listing at least two disadvantages for each method. Then, decide which system *you* think the Austins should use.

Additional Questions

1. Although economically sound, feedlots present the possibility of many biological problems for cattle in the lots. Name and describe as many of these problems as you can think of.

2. What is a monoculture? What special biological problems does a monoculture present for a farmer?

3. If expense is *not* a factor to consider, which is preferable for use as a fertilizer: chemical materials or natural manure? What would be the advantages and disadvantages of each?

4. Find out how feedlots are used in chicken farms. What benefits does the feedlot offer the chicken farmer *other than* convenience of feeding? Is this convenience the *most important* reason for having feedlots for chickens?

5. In feedlots, chicken farms, and other "animal factories," animals may be physically restricted for their whole lifetime. See if you can find out how these facilities are designed and constructed. Do you think it is humane to treat animals like this? Do animals grown for human consumption have any "rights" at all? Explain your answer.

Case Study #4: Carcinogens in your backyard

For the past decade your state government has maintained a strong commitment to the protection of environmental quality. Strong anti-pollution laws have been passed. Working conditions have been carefully regulated. Exposure of consumers to dangerous food additives, pesticides, drugs, cosmetics, and other potentially harmful chemicals has been carefully monitored. All in all you can be proud of the way the state has tried to protect its citizens from many harmful by-products of modern science and technology.

But the governor and legislature are now beginning to see some adverse results of these policies. Businesses feel severely restricted by what they see as excessive governmental control. In many cases, corporate profits have been substantially reduced by the costs of conforming to the state's environmental regulations. A number of corporations have left—or are now planning to leave—the state for more congenial business locations.

The issue around which the most recent business-environmentalist battle is about to take place concerns the dumping of hazardous chemical wastes. Chemical industries account for about 15 percent of the state's business income and are seen as playing a vital role in its economy. Growth in the industry is obviously good for the state. A sound chemical industry

means more jobs, increased tax revenues, and a stronger overall economy.

But it is becoming clear that growth in the chemical manufacturing industries (CMI) is going to increase the problem of waste disposal. For many years companies simply dumped their wastes into lakes or rivers or buried them underground. Events in the late 1970s and early 1980s showed how unsatisfactory these methods of waste disposal were. Chemical dumps were not only an ugly, smelly nuisance, they could also be a serious hazard to human health.

In order to encourage the growth of chemical industries, while maintaining its commitment to a safe environment, the state has developed plans for a Central Waste Disposal Center (CWDC). At this point, the five suburban areas proposed for this chemical dump have all voted against the project. In each case, citizens of the communities acknowledged the need for a CWDC, but insisted that it be located "somewhere else." At this point, the state has decided to suggest one more location: your town. If your community also rejects the plan, the CWDC will be built on the present site of Barkwell State Park. All 180 acres of the park will be converted to a chemical dump, providing enough space for chemical wastes for the next forty years (according to present estimates).

The Buck Stops Here

As chairperson of the local committee for a better city, your opinion on this issue will be very influential. You should decide under what circumstances, if any, the CWDC would be acceptable in your town. What construction, maintenance, or other restrictions would you demand in order for the project to be located in your community? Suggest a *specific location* in the community for the CWDC. Remember that failure to accept the proposal will result in the conversion of Barkwell State Park to a chemical dump.

Additional Questions

1. This question refers to chemical industries located near your home. Find out the name of any businesses to which that description applies. This might be a steel plant, a plastics factory, a smelter, a drug manufacturer, or another industry of this kind. Then find out what waste products this industry produces and what it does with these wastes. You should probably talk with representatives of the industries themselves and with any government officials concerned with this question (a public health official or environmental protection agency officer, for example).

2. In 1980, the United States government established a "superfund" to help pay for the enormous costs of cleaning up chemical waste sites. Find out what this superfund is designed to do (more specifically), how it is funded, and how it is working at the present time.

3. The "Love Canal incident," described in readings below, is one of the most famous issues involving chemical wastes in recent years. Find out the facts of the story, and then determine what the response of (1) local governmental officials, (2) representatives of industry, and (3) residents of the Love Canal area was to this incident.

4. How does the government or an industry determine that a particular chemical is "hazardous"? For some substances (cyanides, for example), that answer is easy. They have been known to be poisonous or carcinogenic for many years. But what about newer chemicals that have been invented or developed only in recent years? Or what about chemicals that are less well known and for which toxicity studies are not available? How are the health hazards of these substances determined?

5. How does an individual determine whether or not a particular chemical is "hazardous"? Suppose that you find out a local factory is producing tributoxyethyl phosphate as a waste product in its daily operation. How would a person find out more about this substance and assess its danger to the community? Try to think of a situation in which this might be a real and urgent problem for an individual.

6. The problem of hazardous waste disposal might easily become a question of relative costs and benefits. How much will it cost a company to do a responsible job of disposing of its chemical wastes? By how much will this reduce the company's profits? At what point does it simply become too expensive to worry about hazardous waste disposal? These are all difficult questions, but in principle they can be answered. The more difficult questions are those of the risks and benefits to humans. What level of risk are we willing to expose a human population to? Is a one percent chance of stomach cancer a "reasonable" risk

for people living near a hazardous waste dump? Can we put a dollar value on human life in case some people are eventually killed by hazardous waste materials? Is this dollar value more or less than the cost of cleaning up hazardous wastes? Some companies are beginning to develop answers to these far more difficult questions of human risk and benefit. See what you can learn about these efforts in current journal and magazine articles.

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Topic four
The sounds of affluence: Noise pollution

Introduction

One of the strange things about pollution is how easily we get used to it. As our favorite lake or river gets too contaminated for fishing or swimming, we simply shrug our shoulders and look for a new recreation area. We may have to drive twenty miles farther, but . . . so what? We may be halfway conscious of the increased pollution in the air we breathe. It seems that our colds last a little longer and our eyes and throats seem to bother us a bit more often, but, after all, no one we know has really died of polluted air, have they? And besides, we have to expect to pay *some* price for progress. Anyway, what can any *one* person do? Certainly we're not going to move just because the air's a little smokier than it used to be!

So it is with noise pollution. There really are few places one can go today to find true peace and quiet. In the city there is the ever-present roar of a mixture of city sounds: car horns, air brakes, subways, air hammers, drills, rivet guns, airplanes, and so on. These sounds are so much a part of daily life in the city that they almost seem like the pulse of the city itself. You can't take away the sounds without destroying the very life of the city. And how much better off are those who live in the suburbs, or even on the farms? The roar of power lawn mowers or farm machinery and the constant hum of expressway traffic are seldom out of hearing range.

So what difference does it make? Who cares if the world's a bit noisier to live in today than it was 100 years ago, or fifty years ago, or even ten years ago? Indeed, watching teenagers listening to the radio makes it apparent that at least some of us even enjoy an increase in noise! Besides, most people who live in the city have become used to noise, just the way they have to air and water pollution. Maybe it just isn't worthwhile or necessary to complain about increased noise levels around us.

On the other hand, scientists have begun to turn up some surprising, and perhaps frightening, information on the effects of noise in our life. It's probably not too surprising to learn that sounds affect us emotionally. Quiet, soothing music (such as Muzak, for example) may tend to calm us down and relax us. Loud, jarring sounds, on the other hand, can irritate or disturb us, making us uneasy and on edge. Can you imagine what it would be like, for example, to live in an apartment directly next to a subway track? A family living in that environment might reasonably be expected to have more quarrels and disagreements than one living on a farm.

Similarly, the effect of noise on intellectual activities, like learning, are fairly well known. It stands to reason that anything that draws the attention of the human brain away from a learning task (such as having on a radio or television set in the background) will tend to *decrease* the effectiveness of learning. And that, despite the claims of some students, has been shown to be true in experiments over and over again.

Most dramatic, however, has been research on the physical effects of sound on the human body. Most of us have seen pictures of high-pitched sound shattering a water glass. So we shouldn't be too surprised to learn that noise can have definite, measurable effects on our bodies. It has been shown, for example, that any loud noise causes blood vessels to constrict, reducing the flow of blood through them. Other physiological effects—dilation of the pupils, change in adrenaline supply and gastric secretions, and tension of muscles, for example—

accompany the constriction of blood vessels.

Continued exposure to loud noises can, therefore, be related to definite health problems. Those with previous histories of heart disease or circulatory problems like atherosclerosis are most likely to be further affected by noise pollution. Men and women who work in noisy occupations are also likely to develop not only hearing defects but also diseases resulting from body damage like that described above.

So, what can be done? We can hardly expect that city living will become, overnight, quiet and peaceful as the country once was. But, perhaps there are some steps that can be taken to reduce the effect of noise in our daily lives.

Case Study and
The Buck Stops Here

The mayor of your town has decided that noise pollution has become a serious social problem for the community. She has appointed a citizen's committee to reduce unnecessary noise. You have been selected to serve on the committee. Your job on the committee is twofold: (1) to find as many sources of noise (no matter how harmless or how serious they seem to be) that you come into contact with each day, and (2) to recommend to the city various ways in which unnecessary and unwanted noise can be reduced in your environment.

As the first step in this activity, conduct a survey of the ways in which noise appears in your environment. List every noise-producing object you can think of—from electric typewriters to pneumatic drills. Then, combine your list with those of others in the class to get a "master" list of noise in your community. By discussing the items on the list, decide which are "harmless," which "unnecessary," and which "harmful, but necessary." (Use any other system of classification you like.) Finally, see if you can think of ways in which the amount of harmful, unnecessary noise you have found can be reduced or eliminated. You may eventually want to report the findings of your study to the city council in your own community.

Additional Questions

1. Is there some way of measuring the relative intensities of the sounds you find? See what you can find out about systems which engineers and sound experts use.

2. How loud is "too" loud? That is, is there a point above which physical damage is produced? How do we know when a sound is "safe" to listen to and when it is a "hazard"?

3. As you look for sounds in your community, you might keep your eyes open for solutions to noise pollution *already* in use. For example, one bank in New York City has hired deaf people to work in a department where the equipment is especially noisy! How satisfactory is this solution and others you may find?

4. A considerable amount of work has been done on the effects of sound on experimental animals (such as rats and mice). See what you can find out about these studies. What does research with experimental animals tell us about the effects of noise on humans?

5. Some students in your class may believe that they can learn better while a radio or television set is playing in the background. Others may think that silence is better for learning something. Think up an experiment which will let you decide which of these ideas is correct. Then carry out the experiment.

6. Are all kinds of noise alike? Is a loud rock record likely to have the same effects on humans as a noisy truck? How much different are records by the Rolling Stones and the Philharmonic Symphony Orchestra, if both are played at the same volume?

7. What kind of conflict would you expect there to be between the improvement of noise pollution and various economic and political factors. That is, what opposition would you expect to get (from the mayor, from local contractors, from union leaders, from . . . ?) in your efforts to reduce noise in your community?

8. A new phenomenon known as "disco deafness" has been studied by medical researchers. The very loud sounds in discotheques has been shown to produce both temporary and permanent hearing losses. See what you can learn about these studies. Based on this information, what, if anything, should be done about the noise levels in discos?

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Topic five
A dead issue? The SST

Introduction

"Progress is our most important product." That slogan of a large industrial corporation might well be the motto for the whole nation. Certainly success for most Americans is defined in terms of "more," "bigger," and "better." The nation's condition is measured not in terms of the "happiness" of its citizens, but as a function of the GNP (Gross National Product).

So, it's not surprising that in almost every business and industry, the aim is to make last year's product newer and bigger and better or, often, simply different. And that's just as true of the airline and aircraft business as any other. Certainly, few industries have been as successful as the builders of modern jet planes. Only fifty years ago, airline companies virtually had to bribe passengers to chance the two- or three-day trip across the country in a fragile aircraft whose top speed was only eighty miles an hour. Today that same trip is accomplished in about five hours in sleek, comfortable jet planes moving at 900 kilometers (560 miles) per hour.

But for aircraft companies, moving 350 people at a time from London to New York City in about seven hours is not good enough. The aim is to cut that travel time in half, or even down to two hours. With this motivation, plans for an aircraft traveling faster than the speed of sound—the supersonic transport (SST)—were started nearly two decades ago. The objective was to construct an airplane that could carry 150 to 200 passengers at approximately twice the speed of sound (about 2,100 kilometers—1,300 miles—per hour) primarily for transcontinental and intercontinental flights.

There are solid economic arguments for building an SST. Since the SST is the next logical

step beyond the widebody, high capacity jets (the Boeing 747, Douglas DC-10, and Lockheed 1011), it has long seemed reasonable that someone would build it eventually. Both a British-French consortium and the Soviet Union already have SST planes flying commercially. If a United States airline decides to add SSTs to its fleet and an American model is not available, it would have to buy the planes overseas. This adds to our already unsatisfactory balance of payment situation. An American-made SST that could be sold to foreign airlines, on the other hand, would provide an attractive and profitable item for overseas trade.

Furthermore, construction of the SST would provide a great boost to employment in an industry where layoffs and unemployment are a chronic problem. Pressure from labor unions, therefore, has been strong for the development of an SST program. Finally, airlines believe that the possibility of even faster air travel (breakfast in Paris, lunch in New York) may hold considerable appeal for busy air travelers.

Even the present availability of the British-French Concorde and the Russian SST has not dampened enthusiasm for an American SST. The cost, capacity, and range of these foreign-made aircraft greatly limit their appeal to United States carriers and encourage further planning by American companies who feel that they can produce more efficient and better all-around planes.

There has not been, of course, unanimous agreement as to the importance and value of an SST. Some critics have raised humanistic and economic arguments against an SST. They claim that the enormous amount of money required for such a project could better be spent on urban housing, cancer research, and similar social problems that affect millions of America's poor, undernourished, ill, and minority groups. The unemployed could as easily be put to work designing and building low-income housing or better urban transit systems as they could in building an SST, the argument goes.

But the most telling arguments against construction of the SST in an earlier defeat of the project may have been environmental ones. Flying such an aircraft at speeds greater than the speed of sound would, for example, produce certain noise problems for people living below the plane's flight path. Effects of a sonic boom may be physical (the shattering of windows in homes, for example), or psychological (the sudden disturbance of an unexpected explosion, for instance). In either case, they are unpleasant and, for many people, unwanted.

The "final straw" in the 1970 defeat of the SST in Congress could have been a last-minute report by a scientist that the SST might have harmful effects on the ozone layer that exists five to ten miles up in our atmosphere. Ozone, an allotropic form of oxygen, acts in the stratosphere something like a protective umbrella, shielding us from the potentially harmful effects of ultraviolet radiation. Flying at its designated height of nearly 20,000 kilometers (12,500 feet), the SST would be passing through this protective ozone layer. The evidence now available suggests that at least one effect of an SST flight would be the breakdown of ozone molecules, with the consequent loss of protection from ultraviolet rays. The effect on humans would likely be a vastly higher rate of cancer resulting from increased exposure to ultraviolet rays.

Case Study: An SST grant

The MacGregor-Bolling Aircraft Corporation has decided to renew its 1968 request to the federal government for financial support for the design of a new American SST plane. Their argument is threefold: (1) that United States airlines are showing increased interest in buying SSTs, (2) that the British-French Concorde will not meet the needs of United States airlines, and (3) that concerns expressed by environmentalists in the 1960s about noise problems and damage to the ozone layer have turned out to be baseless. Plans call for construction of a prototype plane to be built and flight-tested by 1990.

The company's request is for a federal grant of $30,000,000 in the present fiscal year, with additional funding of $30,000,000, $60,000,000, and $90,000,000 in the next three years. The company would match the federal funds for each of these four years and would begin to assume full financial responsibility for the project in the fifth and succeeding years. MacGregor-Bolling points out that government assistance is essential to the project since the company itself cannot risk the money needed to start on the project.

The Buck Stops Here

As a member of the Senate Committee on Space and Aviation, would you favor or oppose the MacGregor-Bolling request? Explain briefly why you take the position you do.

Additional Questions

1. Review articles on the SST controversy, which reached a climax around 1970. Summarize the arguments that seemed to

be most effective both *for* and *against* the project.

2. Suppose you oppose the MacGregor-Bolling request. Do you believe that the SST will *forever* be rejected by the United States Congress? What conditions do you think might make a favorable response to the SST possible?

3. Why is it that the Congress is so actively involved in the question of building an SST? Why doesn't some airplane company simply go ahead and produce it on its own?

4. Examine the earlier arguments for and against the SST (Question 1) and see how they may have to be modified today. That is, what new social or economic conditions would have to be taken into consideration if the project were to be reconsidered today? What new or modified scientific information is now available? Give special attention to the commercial record of the French-British and the Russian SSTs. Also find out what we now know about SST effects on the ozone layer.

5. In what ways—politically, economically, or scientifically—does the existence of Russian and British-French SSTs affect the future possible construction of an American SST?

6. Suppose you were on a planning commission for the design of a new super airport in the Miami area. The new facility should be able to take care of all forms of air travel expected within the next thirty years. What kind of improvements in air travel (SSTs, rockets, etc.) can be reasonably expected to be put into service within that time? What special facilities will the airport have to include to accommodate these new forms of air travel? (Think of environmental problems especially.)

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Topic six Patriots or war criminals? Science and the military

Introduction

Science and the military have been partners for a very long time. At least as far back as the Greek and Roman civilizations, military strategists were turning to scientists for new inventions to aid them in their battles. And that pattern has continued throughout history. Superior science and technology have often provided that extra margin of difference needed to win a battle or a war.

That fact was never more evident than in World War II, however. Most military historians argue that the ultimate triumph of the Allies was a result of scientific developments in Great Britain and the United States. Radar and the atomic bomb were the two major developments that stopped the advance of the Axis, turned the war around, and brought eventual victory. By the end of the war, most governments were of one mind on the role of science in warfare: The nation with the strongest research establishment was going to be the most powerful military force also. More than ever, science and technology had become the right hand of warfare.

The Asian wars of the 1960s and 1970s showed how completely the United States had subscribed to that idea. At no time in history had a nation employed such sophisticated scientific weaponry in war. Chemical and biological warfare (CBW), weather modification techniques, "smart" bombs and aircraft, elegant (and horrible) anti-personnel weapons, electronic devices, and many other scientific and technological inventions were put to use. Some critics have even argued that the military saw the Vietnam War as

The hydrogen bomb is probably the greatest single weapon yet developed by humans. Are the scientists who participated in the development of this weapon heroes or criminals . . . or neither? Explain your answer. (photo courtesy of U.S. Air Force through Department of Energy)

a rare opportunity—not to be lost or wasted—to test out its new weapons systems.

So, is there anything either surprising or improper about the partnership between science and the military? Surely any country engaged in a war intends to win that war. Whatever means can be marshalled to achieve victory, then, should be accepted as legitimate parts of the military strategy. And science and technology have, by their very nature, been among the most valuable sources of military weapons.

The question is whether we really believe in victory at *any* cost? Some people think not. Perhaps as long as humans could, at worst, throw spears and shoot arrows at each other, anything could be considered "fair" in warfare. But, one positive result of World War I was the dawning realization among nations that there must be some limits and some sanity even in the most inhumane of human activities, warfare. As a result, the Geneva Convention of 1925 adopted certain ground rules as to what might and might not be acceptable behavior in war.

Included among the prohibitions in the Geneva Protocol was a restriction against the use of "asphyxiating, poisonous or other gases," and against "bacteriological means of warfare." This provision was inserted because of some of the horrible gas attacks (involving both chlorine and mustard gas) used during the First World War. The idea of using poison gases or of releasing harmful bacteria has struck most politicians and laypersons (although not necessarily the military) as too monstrous even for warfare. Thus, few countries have admitted to carrying on research in chemical or biological warfare. Those that have admitted to such research usually insist that they are doing so only for defensive purposes; that is, so they will know how to protect themselves against chemical and biological attacks made by other nations.

And yet, that nagging feeling remains: If a nation is involved in a struggle for its very existence, shouldn't it be prepared to use any means to win its victory? This issue has still not been resolved in the United States. The 1960s and 1970s saw increasing efforts to de-escalate the Cold War with the Soviet Union. Presidents Nixon, Ford, and Carter made attempts to reverse what appeared to be an inevitable slide towards a new global nuclear war. The Strategic Arms Limitations Treaty (SALT) talks were a major step in that direction.

Plans to cut back on our CBW arsenal were also announced. In November of 1969, President Nixon announced that the United States was withdrawing from any further research on chemical and biological weapons and that certain important installations engaged in this type of research were being closed down. At the same time he also submitted the 1925 Geneva Protocol (which the United States had never signed) to the Senate for approval. The uncertainty of the President's commitments to CBW disarmament was clear, however. The Commandant of the Army's Chemical Center and School at Ft. McClellan, Alabama, said that the President's action did not mean that the United States was no longer interested in CBW. "Nothing could be further from the truth," he said. Research would continue, he pointed out, on defensive aspects of chemical and biological warfare. In addition, the United States would continue its option of developing various types of tear gas and herbicides used in Vietnam. This position was reflected in the fact that when Nixon submitted the Geneva Protocol to the Senate, he indicated that tear gases and herbicides were to be exempted from the protocol's provision, a step no other nation had taken.

The election of President Reagan in 1980 saw the United States turn once more to a more aggressive military stance. Reagan's first defense budgets provided dramatic increases in funding for sophisticated new weapons systems. Most of these required an accelerated program of scientific research and development. The "neutron bomb" project, cancelled by President Carter, was renewed by President Reagan and became the symbol of the "no-holds-barred" military policy of the new administration. Increased interest in and funding for CBW were another indication that the United States was willing to consider *any* weapon for its military warehouse.

The Reagan administration's military policies horrified many critics. The use of science to produce ever more terrible weapons of war seemed, to some, to have only one possible ending: a war whose consequences to the human race would be more horrible than can be imagined.

A growing number of scientists, engineers, and physicians became concerned about the military uses of science and technology. Organizations were formed, conferences were held, and educational campaigns began to inform the general public of the dangers they saw. The United States in the 1980s had obviously still not decided the most fundamental question of all: What limitations, if any, should be placed on the way the forces of science and technology are to be used in warfare. As these forces become ever more powerful, that question can only become more and more difficult.

Case Study: A job opportunity

Dr. Armley C. Tankk is one of the nation's leading experts on binary chemical weapons. He has recently received a grant of $3.8 million from the Office of Research, Department of the Defense to continue and expand his research on chemical weapons. You are a graduate student in chemistry and have been offered a position on Dr. Tankk's research team. The salary you earn on the job will be adequate to permit you to finish the last four years of your research at the university.

You consider the pros and cons of the opportunity. You realize that the work being done is at the forefront of research in chemical weaponry. There are chances for exciting new breakthroughs that could establish your career in chemistry. You feel a certain amount of patriotic motivation since you believe other nations may be working on similar projects. And, of course, you will be financially secure for four years, a tempting prospect in a time that is increasingly difficult for graduate students since federal aid to higher education has been cut back so drastically.

On the other hand, you are worried about the moral implications of the project. You realize that the research has one, and only one, application: as a weapon. There is almost certainly no way that life will be healthier, safer, or better for those on whom the research is used. You also recognize that the weapons you will be developing may be used as easily in the United States for domestic crowd control by the police as they can against foreign enemies.

The Buck Stops Here

This is a difficult decision for you, one that could change the course of your life in a number of ways. You want the best advice possible on the issue. Ask other students in the class to play the roles of those whose opinion you want to have. These might include:

1. Dr. Tankk
2. Director of research, Department of the Defense
3. Fellow graduate students in chemistry
4. Director of the bureau of research at your university
5. Other instructors at the university
6. Friends and relatives who have no connection with the university or the government

Assemble a group of these individuals and allow them a chance to exchange their ideas on this question. Then, make up your mind about Dr. Tankk's offer. Prepare a brief statement that explains the most important reasons for your decision.

Additional Questions

1. Can you see ways in which the issues of chemical warfare and biological warfare are separate and distinct issues? Could you argue for one and against the other? Try to do so.
2. How do you think chemical or biological weapons might be used in the case of domestic uprisings? Is this possibility overemphasized by critics of chemical and biological warfare?
3. Some people would argue that chemical weapons can be humane weapons as they can be used to merely stun or disable enemies who might otherwise be killed in war. How do you feel about this argument?
4. President Nixon specifically requested that herbicides be excluded from the Geneva Protocol when he submitted that treaty to the Senate for its approval. His argument was that these chemicals are used against plants and not against humans. They are, therefore, humane weapons. Explain why you would agree or disagree with this viewpoint.
5. What should be the attitude of scientists toward military research? Historically, scientists have not been especially hesitant about cooperating with the military in the development of new weapons (Vietnam may be the best example of this fact.) Should they accept this role as a patriotic responsibility? Or should they refuse to work on such projects for humanitarian reasons? How should they decide what to do?
6. The case study refers to "binary chemical weapons." What does this term mean? Is the development of binary weapons a step in the right direction in chemical warfare? Why or why not?
7. Some observers see exciting military applications in the field of genetic engineering. See what you can find out about these ideas and then decide how you feel about them.
8. Some members of the scientific profession have become very outspoken about the government's foreign and defense policies. Pay special attention to

the "Letters" section of *Chemical and Engineering News*, mentioned in the *Background Reading List* below. After reading some of these references, decide whether you think professional scientific organizations and journals should become involved in political debates over military policies. (Refer also to PART THREE, topics 2, 3, and 4, on the relationship of science to politics.)

9. In 1981 an Israeli air raid on Iraq destroyed a nuclear power plant supposedly built to generate electricity. The Israeli argument was that the power plant would also be able to turn out the raw materials needed for a nuclear bomb. Find out whether or not this argument is correct. If it is, what implications would this have for United States plans to sell reactors and nuclear fuel to other nations?

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Topic seven
More than just talking about it: Weather modification

Introduction

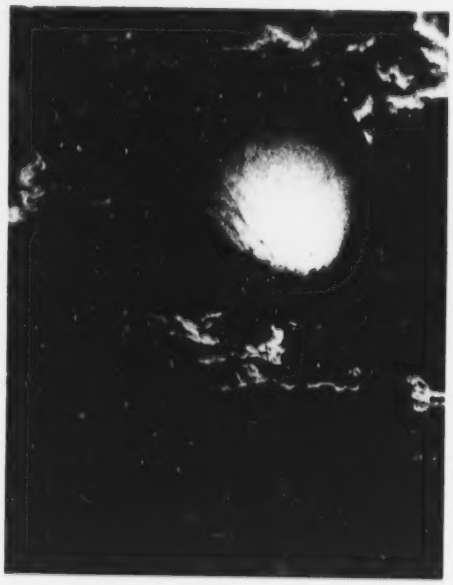
Our desire to manipulate the weather is not new. As far back as we can go into history and prehistory, we find examples of human attempts to understand and influence the weather. Dances and other ceremonies intended to bring rain are a familiar part of many primitive cultures. Even relatively advanced modern societies have tried to find magical, mystical, religious, and scientific techniques to prevent hurricanes, tornadoes, and other storms, and to make it rain or not rain at the "right" times.

Weather studies received a big impetus during World War II when it became essential to know when and where cloudy or stormy weather was going to occur. Those years saw the development of such important theories in meteorology as, for example, explanations of the formation and effects of warm and cold fronts. Today, twenty-four- and forty-eight-hour forecasts are approaching the level of being foolproof in some areas. And it seems as though we can look forward to very accurate forecasts for periods up to two weeks in the near future.

The benefits of accurate weather forecasting are many. Anyone planning to go fishing or hunting, take a vacation at the seashore, have an outdoor wedding, or make a thousand and one other everyday decisions will be better off knowing whether they can expect clear or stormy skies. From an economic standpoint, the benefits to farmers are enormous. According to one estimate, hailstone damage alone has caused up to $300 million loss annually. Not all such damage can be avoided, of course, but considerable savings can be realized when farmers know what to expect. Protection of human life is yet another product of weather research. Hurricanes, tornadoes, and other severe storms represent a threat not only to buildings and crops, but also to human beings. More than a thousand lives were lost, for example, as a result of tornadoes that hit in the United States between 1960 and 1970.

Many factors have contributed to our improved weather forecasting. First of all, we now have a much better understanding of *what* weather is and *why* it occurs the way it does. In other words, we're beginning to develop a real *science* of meteorology. Moreover, there are a number of new devices and techniques which make the study of weather more productive. There are thousands of observing and reporting

Scientists launch a weather balloon. Research on weather modification is sometimes funded by the federal government. What reasons are there for spending public tax dollars on this kind of research? What reasons are there for not *using public money for this kind of research?* (photo courtesy of Argonne National Lab, DOE)



stations that provide up-to-the-minute information on weather conditions in every part of the world. Then, there are banks of modern, high-speed computers which can accumulate and analyze all this incoming data. Finally, and perhaps most important, there are orbiting weather satellites which provide us with photographs of weather conditions over the whole face of the earth.

Understanding weather, however, is only the first step along a more ambitious road toward the *control* of weather. The one area in which the greatest success in this line has occurred has been in rainmaking. Meteorologists have long known that the formation of rain depends on the presence of microscopic impurities like dust or soot in the air. Without such impurities there is nothing on which moisture will condense, and there is no rain. In the 1940s efforts were first made to "seed" clouds by adding artificial impurities to give moisture something to condense on. At first, dry ice was tried, but lead iodide and silver iodide have also been used with success. Over the last twenty-five years, rainmaking efforts have met with variable results. Some have been quite successful, while others have been miserable failures. An especially useful tool in later developments to produce rain has been the computer, which can be programmed to "read" clouds and decide which are the best bets for seeding experiments. Using these techniques and under the best natural conditions, rain production has been increased by as much as 1.5 times.

The ability to control weather, however, has turned out to be only the tip of a much larger and more complex problem. As you can imagine, not everyone in an area will want exactly the same kind of weather at exactly the same time. Anyone who wants to change weather conditions has to consider the possible effects on all residents of the area.

The two case studies that follow present quite different aspects of this issue. The first concerns efforts to change the amount of snow that falls over a section of the United States where precipitation is an ongoing problem. The second deals with the use of weather modification as a military technique. It was not conceived of as a kind-hearted attempt to make the lives of humans in a particular area safer, healthier, or more pleasant. It was developed as a weapon of warfare. As you examine the two cases, you might think about ways in which they differ from each other and how, if at all, they share some common features.

Case Study #1: Helping out Buffalo

One example of the dilemma produced by human efforts to tamper with the weather is the proposed program of snow control in the area of Buffalo, New York.

As a result of its geographical location on the edge of Lake Erie, Buffalo receives some heavy snowfall—often as much as 250 centimeters (about 100 inches)—each winter. This snow creates many problems for the second largest metropolitan area in our second largest state, and plans have been developed for reducing Buffalo's snow burden. By seeding clouds over the lake, meteorologists believe they can change the type of snow that falls and spread it out over a larger area. If the plan worked, there would be some obvious advantages to the citizens of Buffalo. On the other hand, not everyone would be likely to regard this experiment as a blessing. What do you think your reaction might be if you were in one of the following positions?

1. The mayor of Elma, about ten miles east of Buffalo;
2. Erie County road commissioner;
3. Owner of the Big Eagle Ski Resort, twenty miles north of Buffalo;
4. Owner of the Thunder Mountain Ski Resort, forty miles south of Buffalo;
5. Manager of the Greater Buffalo International Airport;
6. President of the Buffalo Chapter of the Sierra Club;
7. Superintendent of Schools for the City of Buffalo;
8. (Choose any other representative of a group that you think might be affected by this decision.)

The Buck Stops Here

Have a group of students representing these viewpoints meet in a town meeting to discuss this issue. Try to reach a decision that is reasonably satisfactory to everyone involved.

Additional Questions

1. In what other ways (other than those described above) might weather modification be used in this country? In other countries? For each example you can think of, see if you can tell how some groups would benefit from the experiment and other groups would be harmed by it.

2. See what you can find out about recent developments in rainmaking techniques. What degree of success do meteorologists now expect? What specific examples can you find of successful attempts at producing rain?

3. Weather modification means more than just rainmaking. See what you can learn about other aspects of weather modification as, for example, tornado and hurricane control.

4. Quite often humans modify the weather in unintentional, accidental ways. Paving over large areas in cities, for example, may change the ground's ability to absorb and reflect heat and light, and thus may affect the kind of weather which occurs. Find out as much as you can about ways such as this in which humans inadvertently change weather and climate. (Make sure you know the difference between *weather* and *climate*.)

Case Study #2: Humane (?) warfare: Artificial thunderstorms or atomic bombs?

Modern developments in science often show up in some unexpected places in society. Few people are likely to think of rainmaking as an instrument of war. Yet, it appears that the military has, in fact, added this technological trick to its supersonic aircraft, atomic cannons, automated battlefields, and all the rest of the highly sophisticated components of its modern arsenal. The idea goes something like this:

Modern warfare depends heavily on an army's ability to move troops and supplies quickly from one place to another. This ability, in turn, is very much dependent upon weather conditions. (Remember how military needs in World War II spurred research in meteorology?) Heavy rains may restrict air flights, flood rivers, and turn dirt roads into seas of mud. Clear weather, on the other hand, provides all the conditions an army needs for maximum mobility.

During the Vietnam war, the United States Army apparently considered the use of—and may actually have attempted—weather modification techniques in curtailing the movement of North Vietnamese and Viet Cong troops along the Ho Chi Minh Trail. By increasing significantly the rainfall in that area by artificial techniques, the plan went, roads would become swampy and impassable and the enemy would be unable to reinforce or supply their troops in South Vietnam.

So far, so good (perhaps), but, as we noted above, our research hasn't developed to the point where we can deliver exactly the weather we want at exactly *and only* the places we want it. Flooding the Ho Chi Minh Trail would also mean drowning and flooding farmlands and forests used by civilians in the area. Although we can't know for sure exactly what the total effect of this effort would be, there is at least the possibility that crops would be wiped out and animal and human life would be lost. Given the still uncertain and unpredictable state of our rainmaking techniques, the final results of this ingenious plan would be highly doubtful.

On the other hand, weather modification has certain advantages as a military "weapon." It is certainly less devastating than conventional or nuclear weapons. If we must engage in war, thunderstorms may be a new and more humane way of fighting battles.

The Buck Stops Here

Would *you* have approved of artificial rainmaking as a military tactic in the circumstances described here? Why or why not? Prepare a position paper that outlines your arguments and be prepared to defend it in a discussion with other students.

Additional Questions

1. Suppose you've been called upon to advise the United States Army about the use of weather modification techniques in the above case. What arguments could you present either for or against the plan described?

2. What do you think about the argument that rainmaking is a humane weapon? Explain why you would regard this as either a logical or an illogical argument.

3. The fact is that we'll never really know whether weather modification is an effective military technique or not until we at least try it. Did this justify experimenting with the technique in the Vietnam war? Explain why or why not.

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Topic eight
The cost of safe driving: Salting our highways

Introduction

Almost as long as we have had automobiles and paved roads, we have also had the problem of icy roads in the winter. Anyone who has driven on these roads knows the feeling of terror that comes when you realize that you are riding in two tons of modern machinery on a glass-like slippery surface . . . and you have lost control of that machinery! For that reason, city and state highway departments have long regarded slippery highways as one of the major problems they have to worry about each winter.

There are a number of possible solutions to the problem of slippery highways. Obviously, one of the best is to scrape off snow and ice before it freezes to the road surface and becomes slippery. That is one of the objectives of plowing streets after a snowfall. But plowing is not always adequate. Another solution is to find some way to increase the friction between car tires and slippery roads. The simplest way to do that is to sprinkle sand, gravel, cinders, or some similar material on the icy roads. Yet another approch is to spread "salt" on streets and roads after snow has fallen and frozen.

Salting icy roads reduces driving hazards in two ways. First, it increases the friction between tire and road, just as sand does. Second, it causes the ice to begin to melt and may, in some cases, actually remove a layer of thin ice from a street. For the past few decades the amount of salt used to de-ice roads has continued to increase until, in 1977, more than ten million tons of sodium chloride were used for that purpose.

For years, there was little or no objection to the practice of salting city streets during the winter. Most people probably felt that the practice contributed to safety, and statistics provided by the Salt Institute supported that belief. But recently, some objections have been raised. The first comes from those who have examined other statistics provided by the National Safety Council. These claim that there has been "no change in the proportion of accidents occurring on ice- or snow-covered roads, even though the use of salt has skyrocketed. In fact, in some towns, the accident rate has risen with the use of salt." The explanation offered for this "fact" is that when salt causes ice to melt, what actually happens is that the moisture produced is held by the salt crystals, making the pavement at least as slippery as it was with the frozen ice. In addition, these critics claim, the false security and spattered windshields that go along with salted roads contribute to the accident rate, rather than reducing it.

And there are other problems. When melted snow and ice finally run off the highway or street, they get into the public sewer system and carry with them the salts used on the ice. The salt level in the public drinking water supply of some northern towns has greatly increased along with the increase in salting of roads. In fact, in some towns where the salt level has risen to about 250 parts per million (the "danger level" as declared by the Public Health Service), salting has been banned. The danger of salt in the public water supply is probably more of a concern to certain groups of people—those with high blood pressure and coronary problems, for example—than it is to the average citizen. Some physicians think that salting of roads might indirectly be responsible for illness and death of individuals with these special medical problems.

Damage to vehicles can also be blamed on the use of salt in the winter. Most salts used for de-icing attack the metal in automobiles quite rapidly. It is a rare car in the northern states that does not come

through the winter without some new pits and rust spots from the "chloride" used the previous season. The Environmental Protection Agency has estimated that $500 million worth of damage is done each year to car mufflers and tailpipes and another $600 million damage occurs in underground pipelines from the same cause. There has been no reliable estimate of damage to grass, crops, and shrubs, but there can be no question that it is considerable.

Case Study: Safe roads or healthy grass: Which is more important?

Hunter's Corners has used calcium chloride (a type of salt used in extremely low temperatures) to de-ice its roads for over twenty years. The town has grown rapidly, its population having increased from 8,500 twenty years ago to 10,370 currently. As the town has grown, the amount of salt used has also grown at about the same rate. Within the last year, members of the local chapter of the Audubon Society have begun to question this use of salt on the town's roads. They point out that numerous newspaper and magazine reports have shown that salting roads is generally ineffective in reducing accidents and that the practice produces a number of unnecessary environmental problems. They have managed to get the question of whether or not to salt town roads on the next ballot. The publicity they are circulating around town contains these points:

1. In the twenty-six years that calcium chloride has been used to salt the roads of Hunter's Corners, the accident rate during the winter months has increased 27 percent.
2. Calcium chloride has been shown to be a highly caustic substance. If held in the palm of the hand for a brief period of time, the salt may cause a painful burn.
3. Surveys of three auto body shops in town have shown that replacement of mufflers and tailpipes and repairs to correct rust spots have increased an average of 164 percent in the past twenty-six years.
4. Spreading sand or gravel dust on the roads would be just as effective as salt in reducing accidents.
5. Counts of wildlife in the five-square-mile township around Hunter's Corners has shown a decrease of 14 percent in robins, 89 percent in bluebirds, 76 percent in warblers, and 45 percent in lake trout.
6. The death rate of Hunter's Corners residents from blood diseases and respiratory ailments has increased by 34 percent in the past twenty-six years.
7. For the past eight years, the town has purchased its supply of calcium chloride from the Dunnington Chemical Company, the only supplier within twenty-four miles. Dunnington is owned by J. Aubrey Pentley, brother-in-law of the town highway commissioner.

The Buck Stops Here

You will choose or be assigned one of the roles listed below. Prepare a position paper which describes the position you believe this individual would take on the question of salting Hunter's Corners roads. Present your arguments in a mock town meeting, a class discussion or seminar, or turn in your paper as directed by your instructor. Roles:

1. Frank N. Hunnest, mayor of Hunter's Corners
2. Robin C. Orion, president of the Audubon Society
3. Hastings Pentley, town highway commissioner
4. J. Aubrey Pentley, owner of the Dunnington Chemical Company
5. Ellison R. Cloudley, homeowner
6. Frances K. Allgee, high school biology teacher
7. Dr. Hootin T. Tutin, professor of mathematics, Hunter's Corners Community College
8. Brad Spicer, district representative, Emerald Salt Company

Additional Questions

1. Are all seven of the above points *statements of fact*? Are any of them statements of opinion? Which points belong in which category? What should be your attitude in reading a statement of opinion compared to your attitude in reading a statement of fact?
2. Of those statements which are facts, how do you know which ones are certainly true, which are probably true, and which may well not be true?
3. Prepare a legitimate statement which could be used to *counter* each of the above arguments.
4. See what information you can find in magazines and newspapers about the use of salt on icy roads. How much agreement

do you find in various articles? How do you make up your mind what to believe, if and when you find two statements which disagree with each other?

5. For a moment, assume that it can be shown that the practice of salting icy roads significantly decreases automobile accidents. What is the "trade-off" then in the practice of using salt? How would you go about deciding whether the "trade-off" is worthwhile or not?

6. When you have read the statements *for* the use of salt for de-icing prepared by your classmates, decide whether you would vote yes or no on the salting question on the town ballot. Write a brief statement which explains why you would vote this way.

Background Reading

"A Shortage of Salt to Pour on the Streets." *Business Week*, February 14, 1977, pp. 34-35. *What can happen when there is not enough salt to de-ice roads?*

Topic nine
Changing a nation's eating habits: Food additives

Introduction

Food just ain't what it used to be! Which may seem like a strange thing to say. After all, yams are yams, tomatoes are tomatoes, and beef is beef, and humans have been eating these foods for thousands of years. The kinds of foods archaeologists find associated with the campsites of prehistoric people would generally be recognizable to modern cooks. And the cavepeople would probably have little trouble recognizing many items on our own dinner tables.

But the fact of the matter is that the foods we eat have undergone a subtle, but very significant, change since the Stone Age. This has been more especially true in the past two generations or so. What is the nature of these changes? There have been changes, first of all, in almost anything humans eat as a food . . . simply because they eat it. Plants that are set off to grow in a special place (a farm), where they receive special care and attention, are likely to evolve in slightly different ways than do their wild cousins. That pattern is even more obvious in the case of cattle and dairy animals, when the herder specifically selects certain animals—the best of the lot—to survive and breed, while others are slaughtered for food.

It took thousands of years, however, before farmers and ranchers learned how to produce new and better plants and animals through carefully controlled selection and reproduction, the process we call hybridization. Today agricultural scientists take it as a matter of course that they can—and will!—produce corn, wheat, lettuce, chickens, beef cattle, and thousands of other food types that exactly satisfy the needs and demands of modern men and women. Plants and animals that constitute our food supply are no longer left to chance, but are "made to order."

A third way in which our foods have changed is the methods by which they are processed and packaged. As long as you can eat your food within a few hours of harvesting it, processing and packaging present no problems. But, to take but one example, eating a whole cow in a single day, or at least before the meat spoils, is quite a task . . . even for a group of teenagers! Besides, some way has to be found for preserving crops grown in the summer so that they can be consumed in the winter. Thus, the problem of food preservation has been with us for a long time.

Salting and smoking meats, two of the oldest techniques, were relatively effective years ago. But few people today would eat a smoked piece of beef or salted pork that had been left unrefrigerated for a month. Science has spoiled us by finding ways of canning, vacuum-packing, freezing, irradiating, or preserving meats and other foods with chemicals so that they look and taste as good weeks or months after slaughtering or harvesting as they did the day after. The success of this effort is reflected in the fact that, as children, your parents could choose from among only a few hundred food items. Today you can pick from close to 10,000!

In some respects, however, the most significant change in the food we eat has been the increased use of *food additives*. This term applies to any chemical which is added to any food for the purpose of preserving that food, making it more nutritious, or changing its natural appearance. To mention just one example of each: salt has long been added to certain foods to preserve them; vitamin D is added artificially to milk to improve your health; and sodium nitrite is routinely added to most meats to maintain their natural, meaty color.

The list of specific chemicals now used as additives runs into the thousands. All of these additives can be classified according to certain special uses such as preservatives, antioxidants, sweeteners, flavoring and coloring agents, emulsifiers, and vitamins and minerals. How do we explain the dramatic increase in the use of these additives over the past generation? We can point out at least three obvious reasons. In the first place, our nation's food supply system has changed greatly since 1900. For most of our history, the majority of Americans lived in rural areas. Getting food from the farmer to the consumer wasn't much of a task since the person using the food was likely to be only a short distance from the person who supplied it. In fact, many consumers were raising most of their own food. Today, the nation is fed by farms which occupy only a small percentage of all our land area. This means that city dwellers in New York City, Boston, Chicago, Philadelphia, Washington, Miami, Los Angeles, and dozens of other big cities may be hundreds of miles and days of travel from their supplies. The problem of preserving foods until they reach the market and are purchased and eaten then becomes much greater.

In the second place, the success of agricultural technology has whetted American's appetites for a greater variety of food than any culture has ever seen. It was once accepted that tomatoes could not be purchased in the winter . . . it was just the wrong season. Nor could you get oysters except in "r" months, or lobsters unless you were willing to travel to Maine. And you were willing to accept oranges even when they were in bad shape, because, after all, they had to be shipped all the way from Florida or California. Our eating habits were modified by the "facts of life" about the availability of foods. No longer is that a sufficient argument for the American consumer. If someone develops a craving for fresh corn on the cob in the middle of December in Detroit, he or she demands that the local supermarket have it in stock. Furthermore, since tastes change rapidly from day to day, the grocer had better have available nearly every conceivable product.

Finally, a powerful factor in our changing eating habits and an important element in the growth of the use of food additives is the changing role of women in our society. It was not so long ago that most people agreed that "woman's place is in the home." This included spending much of her time preparing foods. Homemade bread, pastries, and rolls, and home-canned fruits, garden vegetables, jams and jellies were an accepted part of most American households at the turn of the century. But times have obviously changed. Many women work outside the home today. Both they and many of their homemaker sisters prefer not to spend long hours preparing food for their families. Thus, homemade bread and many other products of the home kitchen have largely disappeared from the American household.

The American food industry has been challenged, therefore, to come up with all the kinds of foods that twenty-five million women used to make in their own kitchens, from chocolate chip cookies to asparagus with Hollandaise sauce, southern fried chicken, and peach ice cream, crescent dinner rolls, stuffed baked potatoes, and beef fondue! They have succeeded, of course, as any trip to a supermarket will readily confirm. Any American family can eat well, even elegantly, with a bare minimum of manual labor on the part of the housewife.

But this convenience has cost a price in terms of the quantity of additives needed to produce this range of foods. Preparing and

packaging a TV dinner in Chicago, shipping it to Houston, leaving it on the shelves for two weeks, and then having it fresh, ready-to-eat, and tempting after forty minutes in the oven requires special techniques and materials that the old-fashioned, four-hour store-to-table dinner never called for. Additives are required to make things mix or to keep them from mixing; to make a mixture soft or keep it hard; to give a food taste and color or to keep it from developing taste or color; to prevent bacteria from growing or to make them multiply faster; to keep fresh fruits from maturing or to make them mature more rapidly; to add vitamins and minerals; or for a dozen other reasons.

So what? What difference does it make that almost any food we eat today contains anywhere from one to two dozen different additives? There is probably *nothing* inherently wrong in eating food additives. Common additives like sugar, salt, pepper, and other spices have been used for centuries to enhance the flavor of foods and make eating more pleasurable. The real problem lies in the fact that many chemical additives have been shown to have deleterious effects on humans or on certain experimental animals. In many of these cases, animals fed special dosages of an additive have developed cancer, heart disease, or other somatic or genetic defects.

The case of cyclamates is only one—but one of the best known—of the many instances in which a widely-used additive was alleged to be carcinogenic (cancer-producing) and was, therefore, removed from the marketplace. The experimental evidence is not very simply or easily explained. Essentially, it was shown that relatively large doses of cyclamates fed to experimental animals (chickens, for example) produced defects in those animals and in litters they later produced. Although cyclamates were being used as sugar substitutes in scores of products at the time this research was being done, this evidence led to their being banned from further commercial use.

Of course, the question of the toxicity of a particular additive may not always be an easy one to answer. When, exactly, does a compound become too dangerous to use in foods? After all, almost anything can be a poison under the right circumstances. Water is generally not regarded as a dangerous compound. But drinking sixty-two gallons all at once would probably have certain harmful effects on a person! Vitamins A and D are both necessary to good health. But excesses of either have been shown to damage the body. Thus, what do we conclude from a study that shows that five grams of compound X per day in a rat's diet induces cancer in the rat, although a human would normally ingest only a millionth of that amount of X each day? Is X "dangerous" or a "poison"? Should it continue to be used as an additive?

Until recently, the use of food additives in the United States was controlled by the Food and Drug Administration (FDA) under a guideline known as the Delaney Clause. The Delaney Clause was adopted in 1958 as an amendment to a Congressional appropriations bill. The Delaney Clause stated that "no additive shall be deemed safe if it is found, after tests which are appropriate for the evaluation of safety of food additives, to induce cancer in man or animal." This guideline meant that *any* additive fed to *any* experimental animal in *any* dosage that produced cancer must be restricted from use.

In 1985, Congress passed new legislation which allowed the FDA to implement a somewhat more liberal policy. According to the new FDA guidelines, a potentially harmful additive may be used only it if can not be detected in an animal by any standard test. In practice, what this means is that possibly dangerous additives may be used provided that the chance of their causing cancer is no more than one in one million.

The case study that follows is relatively brief, but it probably contains as many important issues as any in this book. It raises such questions as the extent to which the food industry controls our eating habits, the way in which corporate profits may take precedence over human health considerations, the role the government has in monitoring the health of individuals, the way we interpret nutritional studies with experimental animals, and the question of whether consumers themselves or industries really create the demand for consumer goods that those industries attempt to meet. As you think about this specific case, try also to develop some positions about these more general questions. Then be alert to other situations in which these general issues reappear in other case studies in the book.

Case Study: Protection we need . . . ! or ?

Dr. Vivian Stark has been studying the effects of potassium phenoxylated bromide (PPB) for almost two years in an attempt to determine its long-range effects on human health. For most of her studies, Dr. Stark uses hamsters, who are fed a total of 0.001 grams PPB in their daily meals. The data from Dr. Stark's work so far is inconclusive. The incidence of retinal cancer in her hamsters is about 10 percent above that normally observed in hamsters. This rate is so low that Dr. Stark is not willing to say definitely that the additive has, in fact, caused the increase in cancer. Besides, the quantity of PPB used in her research is about 100,000 times as great as

that normally eaten by an individual in a whole week. Smaller amounts of PPB have not been shown to produce any serious damage to the hamster's health. The data so far is just not clear-cut enough to say that PPB definitely causes cancer and that it should be removed from the market.

On the other hand, PPB is widely used in the preparation of white bread. Millions of men, women, and children are exposed to the compound each day. Exactly what the long-term effects of PPB will be, and the answers to other questions about PPB may well not be known for years. But if it turns out to be true, that PPB can cause cancer in humans, it's possible that hundreds or thousands of people will be doomed because of the PPB they ate this year.

A strict interpretation of the Delaney Clause would probably require that the use of PPB be banned immediately. Such action may not occur, however, because of an important economic factor. At present, PPB is the cheapest and most widely used agent for producing smaller holes and better consistency in bread. Restrictions on its use would cost the baking industry millions of dollars annually. Simon J. Bunn, president of the Amalgamated Bakeries, has said, "Dr. Stark's studies at this point tell us nothing at all about the dangers of PPB to human health. We vigorously support all additional research efforts aimed at clarifying the role of PPB in human nutrition. In fact, we have awarded Dr. Stark a grant of $1,000 to continue her important work. But until more substantial evidence is obtained, we feel that the use of PPB by the baking industry should not be curtailed."

Reaction to that statement has come from State Representative Hollard F.X. Dimmley. Rep. Dimmley has issued the following statement:

"The continued use of PPB represents an immediate and serious threat to the health of the American public. Research evidence suggests strongly that there is an increase in the rate of cancer in certain animals fed PPB. In view of the nature of cancer itself, we can reasonably expect to find an increasing rate of the disease with longer use of the chemical in future studies. In any case, we can hardly afford to gamble with the lives of millions of children by allowing continued use of this dangerous drug."

The Buck Stops Here

As a staff consultant working for the United States Food and Drug Administration, what recommendation would you make about continued use of PPB in the production of white bread? Take a stand based on the information you presently have (this can be a "tentative ruling") and then decide what further information, studies, or opinions you would need to have to make a final decision. How would you obtain the additional information you need?

Additional Questions

1. Examine the statements of both Mr. Bunn and Rep. Dimmley. Decide how correctly each states the present status of PPB research. Where, in each statement, is factual information alluded to? Are the facts accurately stated? Where in each statement are opinion and propaganda to be found? Prepare a one-page response to either of these two statements.
2. What special considerations must be given in the analysis of research data on the effects of food additives in the diets of hamsters, guinea pigs, or other research animals?
3. In the case of possible carcinogenic materials, cancer may not begin to show up for many years. What length of time constitutes an adequate research study on a food additive? Explain how you reached the decision you did.
4. What changes in circumstances between 1958 and 1985 might have prompted Congress to change its feelings about the use of potentially carcinogenic food additives?
5. Examine the products on the supermarket shelves and make a list of all food additives you find. Then find out how or why each additive is used. Also see if you can find any reports of possible damaging effects of any of these additives. A useful source of information is the *Eater's Digest*.
6. The production of white bread is something of a classic story of the way America's food industry "doctors up" natural foods. We are told that bread is made by taking certain things out of natural wheat, and then putting in a number of artificial additives. See what you can learn about this process, how and why natural wheat is processed, and what additives are used and why.
7. Sometimes chemicals are added to foods *before* they're processed. Additives of this type might be used, for example, to

speed up or slow down the growth of some natural product. In recent years, a good deal of controversy has surrounded the use of diethylstilbesterol (DES) in fattening cattle for the market. See what you can find out about this controversy, then decide what restrictions, if any, *you* would place on the use of DES.

8. The federal agency with the major responsibility for monitoring the use of food additives is the Food and Drug Administration (FDA). Find out how, in general, the FDA works, the kinds of criticism leveled at it, and the ways in which it has reacted to such criticism.

9. Which of the two policies described in the introduction, the Delaney policy and the current policy, do you think is more reasonable and a better policy? If you can think of yet a third policy that would be better than either or both of these, describe such a policy.

10. Some people feel that the problems of food additives can be avoided by eating only "natural" or "organic" foods. What do these two terms mean? Do they mean the same thing? What arguments are there for and against the exclusive use of natural or organic foods?

11. Suppose that you were to come to the conclusion that you are consuming too many chemical additives in your daily diet. What could you do to reduce the intake of food additives? How would this affect your general health, overall?

Background Reading List

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Hundley, Tom. "Additives Anonymous." *Washington Monthly*, February 1982, pp. 42-46. *The strange political situation which makes it possible for the beer industry* not *to have to list its ingredients.*

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Megown, John W. "Topsy-Turvy Times for Agriculture." *Vital Speeches*, October 15, 1979, pp. 16-18. *How "overregulation" is hampering American farmers.*

"Nitrites and Nitrosamines: Is the Hot Dog an Endangered Species?" *Consumer Reports*, May 1980, pp. 310-311. *A good explanation of the problems surrounding the use of nitrites as a food preservative.*

Schell, Orville. "What This Country Needs is a Stronger White Rat." *Mother Jones*, February/-March 1979, pp. 32-40. *Inside view of a food technology convention.*

Smith, R. Jeffrey. "Ever So Cautiously, the FDA Moves Toward a Ban on Nitrites." *Science*, September 8, 1978, *pp. 887-891. The role of nitrites as food additives, and the federal government's dilemma about permitting their continued use.* But then read September 5, 1980, pp. 1100-1101.

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Sun, Marjorie. "Food Dyes Fuel Debate Over Delaney." *Science*, August 23, 1985,

pp. 739–741. *The nation's official standard on food additives is brought into question.*

"Too Much Sugar?" *Consumer Reports*, March 1978, pp. 136–142. *How much sugar do we get in our foods, how much control do we have over it, what are the possible health effects of our sweet-tooth diet, and how does one major food company deal with this issue?*

Topic ten
Keeping it all going: Our energy resources

Introduction

Imagine a family (the Riches) with no source of income except for a very large inheritance left to them by grandparents. The inheritance is so large, in fact, that it looks as if the Riches will be able to live in complete luxury and comfort for the lives of parents, children, and probably well beyond! Thoroughly assured of its future, the Rich family begins to improve its standard of living markedly. Every new appliance or luxury item that appears on the market is gobbled up, and the Riches even hire their own craftsmen just to make that exact object which they want, but can't find anywhere on the market. With no concern about providing for their future, Mr. and Mrs. Rich continue to have more children until the family becomes very large. And every new addition to the family reinforces the family rule: "Spend, spend, spend!"

One day, it suddenly becomes apparent to Mr. and Mrs. Rich that their enormous inheritance may not, in fact, last forever. Indeed, a little calculation shows that at their present rate of spending, the Riches may well run out of money within their own lifetime, and the family will surely be "broke" by the time the children become parents themselves. There is only a very small income from stocks guaranteed for the life of future generations. Suddenly, financial disaster seems unavoidable for the Rich family.

The obvious solution, of course, is for the Riches to cut back on their way of life, living more simply and spending less money. That's probably far more difficult for them to do than it sounds for a number of reasons. First, the Riches have become accustomed to a high standard of living, and they may simply refuse to return to a simpler life until they're absolutely forced to do so. Moreover, a number of their

expenses are long-term, firm commitments, such as the mortgage on the house, and cannot be gotten rid of easily. Finally, Mr. Rich has been tinkering with some clever inventions in his free time, and everyone thinks (or at least hopes) that some day one of those inventions will be a great success, and the family will again have its financial future secure.

This little allegory is a simplistic, but essentially accurate, view of the current energy crisis in the United States. The vast inheritance this family-nation has received is an enormous bounty of the fossil fuels—coal, oil, and gas—produced and deposited beneath the earth hundreds of millions of years ago. By whatever process these precious resources were produced, our nation was uniquely blessed in having more than we could ever use—or so it seemed. After mining coal and pumping petroleum and natural gas for over 100 years, this nation may have more than thirty billion barrels of oil, and 1,500 trillion cubic feet of natural gas within its continental boundaries!

We have built an economy which literally runs on the fossil fuels. The cars we drive to work, the trains and trucks that carry food to the cities, and the airplanes that have shrunk our nation to only "five hours wide" all operate on the refined products or crude oil. Heating plants that warm homes, businesses, and public buildings and cooling systems that air condition those same places all rely on a fossil fuel in one form or another. The operation of the vital industrial sector of our economy—steel and iron refineries, automobile production factories, smelting plants, and the like—depend on the combustion of coal, oil, or natural gas. And, of increasing importance, the production of electrical energy comes almost entirely from fossil fuel-burning generating plants.

The statistics of our energy use are truly overwhelming, and fairly well-known by this time. Although we possess only about 6 percent of the world's population, we use more than 35 percent of the energy consumed on this planet. One way to describe our use of energy is that we have the equivalent of eight slaves working for each one of us to maintain our modern affluent way of life! More than that, the *rate* at which we are consuming energy is increasing rapidly. Take the case of electrical power. Just twenty-five years ago, we were consuming about 4,000 kilowatt-hours of electricity per capita in this country. By the end of the 1980s, we are likely to be using nearly four times that amount (about 14,000 kilowatt-hours per person)!

What these figures all say is rather simple and straightforward. We're simply using up our energy resources at a faster and faster rate each year. But more than that, our resources are not increasing *at all*, or hardly at all. Certainly, there is little reason to believe that any more of the fossil fuels are being made in the earth right now, so that when we've used up our present supplies, that's the end of them. Period. How far away is that day? For coal, perhaps as much as 300 years or more, to be optimistic, but for oil and natural gas, perhaps as few as twenty-five years, to be pessimistic.

What happens then? Many answers are possible. Alarmists claim that our very nation may collapse. We've become so thoroughly dependent on the fossil fuels, they say, we've done so little to develop alternative energy supplies, and we have so little time in which to work out solutions that there's no hope for solving this most difficult of all technological problems. Of course, we could try to reduce our demand for energy. We could drive smaller cars less of the time, produce fewer luxury goods, and make less use of those same goods in our homes. Such a move would certainly cut down on our consumption of energy. But it flies so strongly in the face of our national ethic—"more, bigger, better"—that it's hard to see how such a plan could succeed.

Still, conservation of existing resources is a possibility we almost certainly have to pursue. The first case study below deals with one method of promoting energy conservation.

Another possibility is to turn to other nations for the fossil fuel supplies we need. This would provide a short-range solution since certain other parts of the world have fuel reserves far exceeding our own. But there are difficulties here too. Those nations who have the oil we need, for example, are often those with whom we have unsatisfactory relations. Buying oil from the Middle East, as an example, introduces some sticky political—as well as economic and technical—problems. Furthermore, foreign oil, gas, and coal reserves are, like our own, limited, and we are only putting off the solution to the energy crisis by a few generations, not actually solving it.

The ultimate solution to our energy problems must eventually come from the development of entirely new forms of energy, not based on the fossil fuels. For example, we already depend on water resources for a very small proportion (about 5 percent) of our power.

For nearly two generations, nations have been looking to nuclear power as the next major energy source. As our fossil fuels run out and before solar, fusion, and other new energy sources are commercially available, nuclear power has been counted on to meet our energy needs. Beginning in the late 1950s, government and industry

moved rapidly into the field of nuclear power plant construction. Some optimists felt that nuclear power could be supplying 40 percent of our energy needs by 1990.

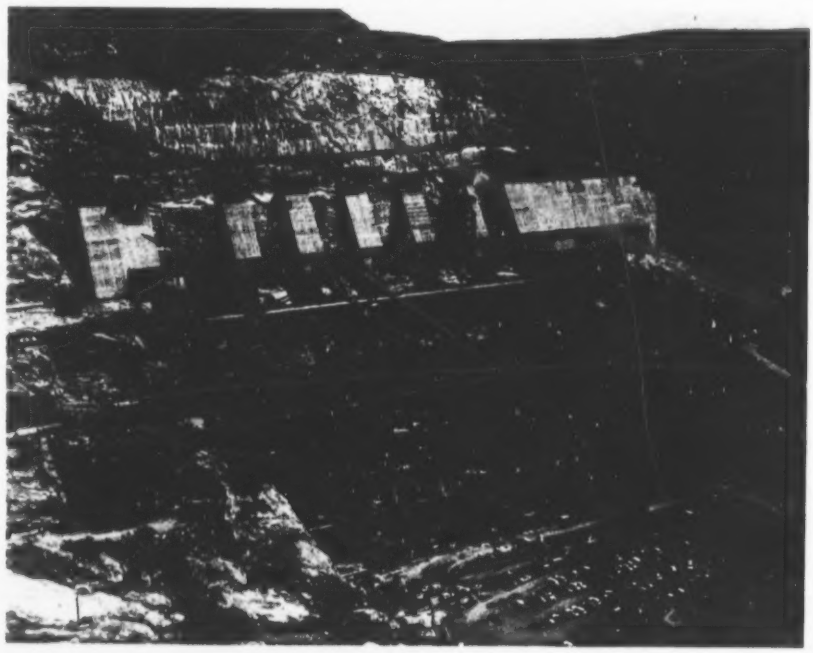
And, for a time, that looked like a reasonable prediction. The number of nuclear plants jumped from only seven in 1965 to seventy-two in 1978. But the mid-1970s saw increasing concern among the general public about the potential risks of nuclear energy. Some of this concern may have been a residue among those who could still recall the horrors of nuclear energy unleashed—in an atomic or hydrogen bomb. But there was also a growing sense of doubt that basic safety considerations in the production of nuclear energy had still not been resolved in the 1970s. Satisfactory methods for the disposal of "hot" radioactive wastes had still not been developed thirty years after the first nuclear power plant had been opened.

The dramatic melt-down at the Three-Mile Island nuclear power plant in 1979 has proven to be a crucial factor in many people's attitudes about nuclear power. Although no lives were lost in the accident, many scientists and laypersons are very concerned about the potential damage from other accidents of this type in the future. By 1982, the difficulties of gaining public support and governmental approval for new nuclear plants were so great, that many companies were cancelling plans to build new facilities. Where this leaves nuclear power as a short-range answer to our energy problems is not clear. The second case study below will give you an opportunity to think about some issues surrounding the use of nuclear power.

Attention has begun to shift to other alternative sources of energy. Synthetic fuels, biomass, hydroelectric power, geothermal energy, wind power, tidal energy, and similar sources of energy seem to provide some partial solutions—short-term and long-term—to our energy needs. It seems likely that, for the very long range, we may be able to count on only two major sources of energy: solar and fusion power. Both are similar and are the ultimate source of almost all energy in the universe. If and when we harness these two, we may at last have found a "final" solution to the energy crisis we face.

The difficulty here is that relatively little research has been done on any of these alternative energy resources. It seems hard to imagine how they will be ready by the time we need them. Oil and coal companies have, of course, vested interests in the fossil fuels and have been reluctant to spend the enormous sums of money needed for research on *other* energy sources. Governments tend to be committed to the status quo, as well as to supporting existing businesses, so that they have also backed off from spending much money on research. Given these powerful economic and political considerations, it's not clear how the necessary alternatives in energy supplies can be developed before it's too late.

At the moment, a fundamental question seems to be, "Who is responsible for developing new energy sources?" With most of the alternative sources listed above, there is no technology available for producing energy at a profit. We *can* convert solar energy to electricity, for example, but the efficiency of solar cells is very low. We know how to make sugar cane into automotive fuel. But it costs more to make the fuel than to buy petroleum from OPEC. We have found ways of getting petroleum out of tar sands. But the process is not efficient enough to



To what extent is hydroelectric power an important factor in the nation's future energy picture? On what do you base your answer? What are some of the advantages and disadvantages of this power source? (photo courtesy of the U.S. Department of the Interior; Bureau of Reclamation)

use commercially. If we *are* to make these processes into commercially viable enterprises, who is to support the very significant costs of research and development? This question provides the focus of *Case Study #3*.

Two of the case studies that follow have a somewhat different emphasis from most of the ones in this book. In the case of nuclear power (#2) and strip mining (#4), the focus is on how people decide about socio-scientific issues. Laypersons are often called to take a position on issues like those in this text, giving opinions or advice, electing officials, voting on referenda, and the like. Is there some systematic way in which a person can decide on these issues? Cases #2 and #4 will help you think more about this question.

Case Study #1: A new energy policy for the state

Some people feel that the current energy situation is serious enough for the government to take drastic action in forcibly restricting the use of fuels. One such person is Roberta J. Hallenback, governor of a populous Northeastern state. Governor Hallenback believes that as long as we leave energy decisions to the whim of individuals, we are doomed to social and economic disaster. If people are allowed to continue to use all the energy they want, as they want it, and when they want it, she believes we will have run out of fuels long before alternative sources have been adequately developed.

Governor Hallenback has developed, therefore, a comprehensive plan for conserving, protecting, and extending energy resources in her state. Three major programs form the basis of her plan: (1) restrictions on the use of private automobiles, (2) rationing of fuel for private transportation and home heating use, and (3) restrictions on the use of energy-consuming "luxury" appliances. Here are some details of the plan:

1. *Transportation:* Private automobiles are to be entirely restricted, between the hours of 9 A.M. and 6 P.M., from the streets of all cities with a population of 50,000 and over. Commuters will have to get into the core city by means of public transportation, and inner-city residents will be required to move around town by the same means. Commercial vehicles (such as delivery trucks) and city residents may drive on city streets during restricted hours, but only after an energy tax of $500 per vehicle per year has been paid to the state.
2. *Fuel rationing:* Gasoline, fuel oil, natural gas for heating and cooking, and fuels used for other forms of personal energy consumption are to be sold only on a restricted basis. Plans are to be developed permitting each citizen a fair share of the energy sources available for private use. For example, only the amount of fuel oil or natural gas required to maintain each private home at a temperature of 64°F will be allotted to each homeowner. Individuals are expected to adjust their living habits to this level of comfort. Gasoline stamps will be issued on the basis of vehicle use. Salespeople and others who require a car in their business will be allocated a greater amount of gasoline than those who use their car solely for pleasure. In fact, "pleasure use" of automobiles will be strongly discouraged.
3. *Luxury items:* An outright ban on certain nonessential, energy-using devices and mechanisms will be established. Among the items on this list will be such gadgets as electric toothbrushes, garbage compactors, "hot combs," and the like. The principle behind this action is that people can perform for themselves a number of activities for which they now rely on machines. For most of human history, for example, we have been able to wash our own dishes. While electric dishwashers are certainly a great convenience, they are no longer the kind of convenience we can afford in terms of the energy they use. Thus, the nonessential, luxury items on this list can neither be advertised nor sold in the state.

The Buck Stops Here

Choose one of the perspectives listed below from which to evaluate Governor Hallenback's proposals. Decide whether you favor or oppose each part of her plan. Develop a position paper to support your decision. Be prepared to defend your decision in a debate or discussion with other class members.

1. Seymour U. Wortley, president, Tri-State Petroleum Co.
2. Elgard H. Hoppe, executive secretary, Mill County Chamber of Commerce
3. Audrey P. Welle, Director of State Public Health Services
4. Lucinda R. Karczyh, homemaker
5. Fester C. Parker, mayor of Metrolita (population - 185,000)
6. Henley Booksby, state director, Citizens for Clean Air

7. Dr. Webster Lane Lawson, professor of engineering, State University at Metrolita
8. Someone with vested interest of your choice.

Additional Questions

1. What desirable features do you see in Governor Hallenback's plan? In what ways would it help her state solve the energy crisis?
2. What modifications would you make in this plan to make it stronger, more effective, or, perhaps, more appealing to the public?
3. The program stresses quite heavily the role of the automobile in the energy crisis. Do you think this emphasis is justified or not? Explain your answer.
4. What objections do you think might be raised against the governor's plan?
5. Watch television ads, read newspapers and magazines, and talk with representatives of various occupations to find out what current solutions to the energy crisis are now being offered by (a) national, state, and local political leaders, (b) coal, oil, and gas company executives, (c) labor unions, (d) scientists, (e) conservationists, (f) medical and health groups, (g) concerned laypersons. Can you identify certain common themes within each group, or do members of a group sometimes disagree with each other? Is there agreement or disagreement across groups?
6. The United States experienced a serious energy crisis in 1973. At that time Arab nations drastically reduced the quantity of petroleum available for sale to the United States and certain other nations. At the same time, they dramatically raised the price on the petroleum they *did* sell. This action was taken at least partly in response to the United States' Middle East policy. Find out the major events that took place during that crisis. How has United States energy policy and practice changed since 1973 as a result of that crisis? Are we better able to deal with a similar crisis now than we were in 1973?
7. In what ways was the 1973 crisis a beneficial event for the major petroleum companies?

Case Study #2: . . . But not in *my* backyard!

The Lakefront Electrical Company has decided to construct a nuclear power plant on Lake Euphrates, eight kilometers (five miles) from your home. Lakefront says that electrical use in your part of the state is growing at the rate of 3.2 percent per year. Current generating capacity will be adequate for only five more years. Given the delays in building and licensing a new nuclear plant, the Euphrates installation will probably not be in operation for another eight years. In order to speed up this process and avoid possible objections from the public, Lakefront has initiated a vigorous public relations campaign to win the support of residents in the immediate area. The company has asked you and nine of your neighbors to serve on an advisory committee that suggests ways of informing the general public on this project.

The Buck Stops Here

You accept the offer of a seat on the advisory committee. You haven't made up your mind how you feel about the plant and realize that this may be the best way of getting the information you need. Meet with other class members who will also serve on the advisory committee. Try to answer each of the following questions:

1. What do you want to know about the construction and operation of this plant?
2. To whom can you go to get the information you want?
3. How can you collect this information?
4. What arguments are there both for and against this project?
5. How do you evaluate arguments between experts on opposite sides of an issue concerning the plant?
6. What people should be involved in the decision to build this plant?
7. How do you provide information about this project to the general public and the "decision-makers" (Question #6)?
8. What efforts, if any, should be made to win over those who do not agree with the final decision of the "decision-makers"?

(Add any additional questions you can think of.)

Case Study #3: Making do with what we have

The American Synthetic Products Company (ASPCo) is a new corporation founded by chemists at five major universities. The company was created to market a method for producing ethanol from peanut

shells. The procedure was invented by two of the chemists and has been found to be workable at the laboratory level. At this point the process is more expensive than the value of the fuel produced. The chemists who own ASPCo are convinced, however, that a commercially successful plant can be built within the next ten years. They estimate that 5 percent of the nation's demand for ethanol in the year 2000 could be met by the peanut process.

The present difficulty, however, is lack of funds to continue research and build a small pilot plant. Efforts to obtain financing from private sources have been unsuccessful. Potential investors are either skeptical of a "peanut-fuel" or see their financial return as coming too far in the future.

As a result, ASPCo has submitted a proposal to the National Science Foundation requesting a grant that would support further research and development on the project over the next five years. The proposal requests $80 million in the first year with guaranteed increases of 10 percent in this amount over the next four years of the program. The company projects that, in less than eleven years, the American public will save an amount of money equal to the cost of the grant by not having to buy foreign oil.

The Buck Stops Here

As a member of the Citizen's Advisory Council on Government Energy Policy, you have been asked to comment on this proposal. The proposal has already been reviewed by the Office of Management and Budget (OMB) which agrees that the process would help solve the nation's energy problems if it can be made to work on a large scale. OMB points out, however, that the request is a large one that can be met only by making cuts elsewhere in the federal budget. One strong possibility suggested by OMB would be to transfer 0.5 percent of the annual Social Security budget to support this and similar energy projects. Based on the information you have, would you tend to approve or disapprove the request? Be prepared to defend your decision in a meeting with other members of the advisory council.

Additional Questions

1. Make a list of alternative sources of energy that could be developed. This list should include hydroelectric power, wind power, tidal power, ocean-thermal gradient power, biomass, syn-fuels, and any other source you can think of EXCEPT solar power (this is covered in the next question). For each source on your list, find one advantage and one disadvantage. Then, select any one of the sources to study in more detail. Prepare a news article, a bulletin board display, a written report, or some other summary of the information you learn about this energy source.

2. Solar energy is often described as the resource on which humans will eventually have to depend. What does the term "solar energy" mean? In what forms does it occur naturally on the earth? Which of these forms are we presently using? Which might be developed in the future?

3. The first years of the 1980s still saw the United States spending relatively modest amounts of money on the development of solar power. Yet, most industries, governments, and individuals recognize the serious energy shortages we are facing. How can you reconcile these apparently contradictory pieces of information?

4. What would be the advantages and disadvantages of solar power in your own community? Your own school? Your own home?

5. Find out how, if at all, solar power is being used in your own community. Interview anyone who is presently making use of this energy source, and find out what advantages or disadvantages he or she has observed for this energy source.

6. To what does the term **syn-fuels** refer? Is this energy resource likely to be a major power source in the United States in the next ten years? In the next fifty years? In the next 200 years? Explain your answer to each part of this question.

7. Explain how the development of alternative energy sources is a different kind of problem (if it is) for each of the following geographic areas: (a) the New England states; (b) Texas and Louisiana; (c) Quebec and Ontario; (d) the western provinces of Canada; (e) Mexico; (f) South America; (g) Nigeria; (h) Japan; (i) the United Kingdom; (j) Iraq and Syria; (k) India. Choose any one of the regions and explain how the answer to your question has social and political implications for the region and for the rest of the world.

8. "Since the development of new energy sources is an enormously expensive activity, and since the development of these

sources is essential to the well-being of our nation, it follows that the federal government should underwrite the costs of research and development on these sources." Explain why you would or would not agree with this line of reasoning.

9. "Since the federal government will have to pay the costs of developing new energy sources for the nation (following the reasoning of Question 8), it should also receive a certain share of the profits made from the sale of energy produced by these sources in the future." Explain why you would or would not agree with this statement.

Case Study #4: Beauty vs. progress

Some major changes have taken place in the coal-mining industry in the last forty years. In 1940, 90.6 percent of all coal mined in this country came from underground mines. The remaining 9.4 percent was obtained from surface ("strip") mines. In 1978, that pattern had been reversed; 62.9 percent of our coal came from surface mines, and only 37.1 percent from underground mines. What had happened to bring about this change?

One advantage of strip mining is safety. Since miners work on the surface, not hundreds of feet below ground, the chances of explosions, cave-ins, and other serious accidents are much less. From an economic standpoint, strip mining is also to be preferred. The costs of scraping coal off the surface is much less than the expense of tunneling for it. For both humane and financial reasons, then, surface mining is a better way to get the coal we need than is underground mining.

But there are some serious problems with strip mining. The coal obtained in this way is often of poorer quality than that found in underground mines. It is in demand now partly because our reserves of higher quality, deep-mined coal are being depleted. Also, the environment damage produced by strip mining can be awesome. In some states, whole sections of the landscape have been devastated by stripping. Most states now have laws requiring companies to restore the lands they strip. But companies differ in the enthusiasm and care with which they do the restoration. After all, money spent on renewal of stripped land must be deducted from the profits of mining. It's conceivable that the cost of renovation would be so high that the mining operation showed no profit at all!

This aerial photograph shows an area in Arizona being strip mined. It's unlikely that very many humans will see the effect of this project. No communities are nearby, and the region is of no interest to tourists. Is there any reason for the mining company to reclaim this land? Why or why not? Is there any reason for the federal or state government to insist that they do so? Why or why not? (photo courtesy of the U.S. Department of the Interior; Bureau of Reclamation)

In any case, the amount of surface mining in the United States seems almost certain to increase. Coal is the one fossil fuel we have in abundance and will probably have to rely on for a very long time. From the standpoint of energy needs, we can hardly afford *not* to continue to expand our strip mining.

A prime location for surface mining that has so far been almost completely untouched is our public lands. National parks, forests, and wilderness areas have been set aside for the recreational use and enjoyment of the American public. Until very recently, most people seemed to think that some parts of our land should be left in a natural state for these purposes.

Our growing energy problems have caused some people to change their minds. As nice as it would be to set aside a lot of these wilderness areas, they think, we are going to have to open more of them to mining and exploration. As a citizen of Atlanta, you have just read of plans to lease 75,000 acres of land in the Dixie National Forest in Georgia to the Rainbow Coal Company. Rainbow estimates that enough coal can be stripped from this land to meet *all* our energy needs for seventeen years.

The company recognizes the environmental problems caused by stripping but offers two responses to these concerns. First, no land will be stripped within 200 meters (660 feet) of any public access road. Changes

in the land will be visible only from a distance or only to those who hike or backpack into the forest. Some restrictions will be necessary anyway, they point out, to protect the safety of the general public.

Also, the company plans to restore the stripped area by covering the section with new topsoil and planting hardy grasses. Twenty years from now, Rainbow argues, no one will realize that stripping ever took place on the land.

The Buck Stops Here

The proposed stripping will take place more than 3,000 kilometers (1,860 miles) from your home. Yet, as a concerned citizen, you want to know what's going on, decide how you feel about the project, and know what you can do if some action seems appropriate. You locate about ten other citizens of the community who are also interested in this issue and meet to discuss the proposed project. Below is a partial list of questions you collect at the first meeting of the group. What answers can you and other committee members (classmates) suggest for each of these questions?

1. What additional information would you like to have about Rainbow's plans?

2. What government agencies, environmental groups, industry associations, and other groups are involved in this issue? How would you find out what these groups are and how you would get in contact with them?

3. What alternatives do you see in this case ("Mine," "not mine," etc.)?

4. Who should make the final decision about the use of this land?

5. How, if at all, are you and your group affected by this issue? What input can you have? Should you try to influence the final decision? Why or why not? If you say "yes," how can you make your feelings known?

6. What responsibility, if any, do you have for trying to inform or influence your friends, other citizens of Atlanta, and/or other Americans about this issue?

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Topic eleven
"Nobody's business but my own": Computerization and privacy

Introduction

The right to be left alone is one privilege humans have probably always cherished. Of course, *Homo sapiens* is a communal species, so this desire is not as simple and straightforward as it sounds. We rely on others to supply us with food, clothing, building materials, and other essentials of daily life. We count on friends and neighbors for help in completing an endless list of tasks on which our survival depends. Today we look to the farmer, the plumber, the carpenter, the doctor, the town clerk, the used car salesperson, and men and women in dozens of other occupations to help us function safely, healthily, efficiently, and happily.

And even if we didn't have to rely on all these workers, we'd probably still seek out the company of others. Religious festivals, weddings, community dances, "market day," visits to relatives and neighbors, and social functions of many types are probably intended, at least in part, to give people a chance to get together and enjoy the pleasures of each other's companionship. And thus it may well have been since the dawn of human civilization. Og and Oop the cave people may not have had the complex, interconnected society we live in today. But they must have rapidly learned the necessities and advantages of interdependence among men and women.

Still, whether discussing a cave person or your fellow citizen, it must be obvious that humans do not—and do not want to—share everything in their lives with others. There are times when men and women want to be alone to think their own thoughts, or do their private things without the intrusion of neighbors, friends, or relatives. Privacy is something each of us needs from time to time. But

physical privacy for oneself is not the only quality we seek. Privacy of possessions is also important. Some objects are *ours*. We have bought them, or even stolen them. We want to make sure no one takes them from us. So we make safes in which to hide our treasures.

Most important of all, perhaps, is the privacy of ideas, thought, and information. Our thoughts may be traitorous, obscene, or otherwise offensive to society. So we want to protect ourself from punishment. Our ideas may be revolutionary, absurd, or simply wrongheaded, and we want to protect ourself from ridicule and abuse. Or our information may be about past mistakes, present indiscretions, or future plans, and we want to keep this knowledge as our own private possession. Whatever the case, we feel and know that some parts of ourselves are our own, not intended for public knowledge. Whether this includes such concrete things as financial status, voting records, and legal affairs, or more abstract things like religious beliefs, political thoughts, or plans for the future, these are all too much a part of our innermost selves to be probed and exhibited before the general public without our approval. Personal privacy is, for many of us, an inherent right.

But privacy is becoming a scarcer commodity in our world, just by the very nature of our modern civilization. Og and Oop probably had neither the range of ideas and information they wanted to keep secret nor the problems in finding a way to get privacy that we have today. Even today, privacy means different things to different people. A rancher in Montana certainly has a good deal more of it than a slum dweller in Detroit. To the rancher, privacy may mean sitting alone on top of a hill miles from the nearest human, her thoughts entirely to herself. To the slum dweller, privacy, if it exists at all, may be nothing more than a moment or two alone on the roof of a tenement with a thousand reminders of a thousand neighbors within yards of him. As society grows and develops, people move closer together and, whatever else happens, physical privacy disappears.

But modern society invades our privacy in another way. Even that rancher in Montana, physically isolated as she is from other humans, has had to give up a lot of her personal privacy just to live in the country. Every few years a census taker comes by to ask all kinds of questions about her personal possessions, and she must answer them or be carted off to jail. Whenever she decides to buy a new car, a new home, or some other expensive object, she must surrender personal information about her financial affairs. Although her contacts with people are few, they frequently involve giving up items of personal privacy . . . trivial items, like her height and weight to the registry of motor vehicles, or not so trivial, like the quality of her blood to the marriage license bureau.

The loss of privacy which the rancher experiences, however, is virtually nothing at all compared to that of the modern urban American. At almost every turn, it seems that someone or some institution is prying into our personal affairs. You cannot interview for a job, apply for a credit card, enroll in an educational institution, see a doctor, or do a dozen common, everyday things without surrendering a vast amount of information about your legal, financial, educational, and personal history. And the farther down the social scale you are the more you have to surrender. Being poor in America means not only giving up physical privacy, but also surrendering other kinds of personal thoughts and information. If you hope to receive welfare, for example, you will probably have to provide the caseworker with the most personal details of your daily life. Participation in certain welfare programs, drug rehabilitation efforts, job training projects, and the like may require that you practically sign your life away to the control of some other person or agency.

All of this may well be inevitable, perhaps desirable, in the kind of world we live in. Financial institutions can hardly be expected to operate on faith and trust. They must *know* whether you're a good credit risk or not. Paupers who expect to live off the public dole can hardly expect to do so and retain the same degree of privacy that self-supporting citizens possess. But even so, there is one aspect of this issue which concerns many citizens. Like so many things in our society, the invasion of personal privacy has been mechanized by the developments of modern science and technology. And along with that mechanization will come yet more and more complex problems.

The computer is the best example. This amazing machine that now controls such a large part of our lives grew directly out of a social problem that appeared in the United States at the turn of the century. The Department of Commerce found in the 1890s that each decade it was taking more and more time to tabulate the results of the ten-year census required by the Constitution. Experts were beginning to doubt whether the 1910 census data could be counted and tabulated before it was time to begin on the 1920 census! Directly in response to this problem, Dr. Herman Hollerith developed the first modern computing machine, and the Census Bureau's problem was solved.

That success story has been repeated many times over in the

past seventy years, with results of which you are well aware. Today banks, lending institutions, credit card companies, oil companies, department, hardware, and other stores, and almost any other institution with large, complex financial records depend completely on the computer. It's highly questionable whether our present financial system could even continue to function without this marvelous machine. Educational establishments, too, rely on the computer to know who their students are, where they are at any particular time, how much money they owe the institution, how close they are to graduation, and so on. Airline companies keep track of hundreds of thousands of seats on thousands of flights daily through sophisticated computerized systems located in New York City, Boston, Atlanta, and other central offices and tied to local reservation offices throughout the country. The largest private data file in the world is probably that maintained by credit bureaus. These organizations, which advise financial institutions on the credit rating of millions of people, are said to have data on more Americans than the FBI and CIA combined, as many as 110 million of us. Information contained in these files relates to such topics as employment history, salary, savings, loans, mortgages, debts, and legal history. Legal agencies themselves maintain records on arrests and convictions of citizens. The New York State Identification and Intelligence Systems, for example, is a computerized data bank (file of information) containing information on arrest, acquittal, and conviction of everyone arrested in the state of New York. Similar data banks, sometimes containing political as well as criminal information, are maintained by other states.

Far and away the largest, most complex, and most detailed collection of computerized records maintained by public agencies is found in the United States government. Anyone who has ever been in the service, worked for the government, applied for government assistance or advice, or filed an income tax report has had at least some personal information filed away in the data banks at the Treasury Department, the Federal Bureau of Investigation, the Central Intelligence Agency, the Department of Defense, or a dozen other agencies. The Department of Defense, for example, maintains a list of at least 25 million names of anyone who has ever worked for the department or applied for a security clearance, whether with government or private business. Chances are that there are very few Americans whose name and financial and personal records, whether scanty or detailed, are not filed away in at least one government data bank.

Within the last few years a proposal for a National Data Center (NDC) has been going the rounds of government offices. The proposed "super bank" would consolidate all existing records from all government offices. This would make it possible, according to some experts, to keep a complete dossier on every person in the United States. A person's record could be retrieved in a matter of seconds. The "Big Brother" aspects of this idea have been too much for most officials, and, for the moment, plans for NDC have been shelved. The obvious advantages of such a system contain a strong appeal to the bureaucratic system, however, and we can expect to hear more about this idea in the future.

By this time, the advantages of computerized records have become obvious to business, industry, and government, if not always to the private citizen. Most large enterprises operating today, private and public, would simply be unable to function without computerized record keeping. But what about the other side of the picture? A few dangers and disadvantages are equally obvious. The most important, perhaps, is the possibility of errors in the records. Although computing machines themselves are very unlikely to make mistakes, the probability of their human "keepers'" erring is much greater. If a keypunch operator incorrectly reads a number off a file card, then punches the error into the data card, the mistake becomes a part of someone's permanent record. There are a good many witnesses to the fact that errors like this are located and corrected only with a great deal of inconvenience and difficulty, if at all!

A second danger is that information once placed into a computer's memory may, thereafter, be available to a great many different individuals and/or groups. Files from the Department of Defense, for example, may be readily exchanged with the FBI, the CIA, or other government agencies. Depending on the specific circumstances, information which was once private thereby becomes virtually public knowledge.

Finally, the computer presents a kind of danger shared by other scientific discoveries: a built-in tendency to magnify and escalate its own capabilities and, hence, its own advantages and defects. By this we mean that the computer is, first and foremost, a machine for keeping track of and computing many numbers. This is the great advantage of using a computer in, say, conducting a census. But the very ability of the computer to do wondrous things may prompt humans to look for *other*, new things for it to count and record. Since the computer does "A," "B," and "C" so well, the reasoning goes, let's also invent some other things—"D," "E," and "F" perhaps—for it to work on also. The

advent of the computer made it possible not only to complete the fairly simple, straightforward task of counting Americans. It also led later to asking an almost endless list of questions of people and businesses in order to get data such as the number of red-haired women with three children living in a rented four-room apartment in a town of 15,000 population, or the number of pounds of bananas flown to the United States from Honduras last year. From the standpoint of this discussion, the invasion of privacy through computerization of records works so well that it only makes it *more* likely that business and government will find other, new ways of taking away your private knowledge!

Case Study: A central data center

Sen. Waxley Fogborn is concerned about the confused state of electronic record keeping in the United States. Hundreds of companies, agencies, and organizations have their own records on millions of citizens, he points out. This results in enormous overlap and inefficiency. A single individual may have records in the computers of the FBI, the Social Security Administration, the Republican Party, the state and local police departments, a half dozen credit agencies, airline companies, and so on. The waste and duplication created by these multiple records costs private business and governmental bodies billions of dollars each year.

In order to deal with this problem, Sen. Fogborn has suggested the establishment of a Central Data Center (CDC) to be operated by the United States Department of the Census. CDC would be authorized to collect *all* electronic records held by *all* agencies, public and private, for *every* citizen in the nation. In the future, any organization requiring information on any individual would request this information from the CDC. The use of telephone lines and computer-to-computer connections would allow this information exchange to take place within a matter of seconds. The CDC would be the only agency allowed to maintain a data bank on individuals.

The Buck Stops Here

You are a private citizen with no special expertise in computers or electronic record keeping. You have been asked to serve on a citizen's advisory commission to recommend action on Sen. Fogborn's bill. With other members of the commission, you should:

1. List the advantages of this proposal. Consider the advantages to:
   a. Federal, state and local governments;
   b. Private business and industry;
   c. Individuals;

2. List potential problems arising from the proposal (again, from each of the three perspectives listed above);

3. Suggest changes in the proposal that would take care of the problems outlined in Question 2 above.

Additional Questions

1. Make a list of all the ways you know of that computers are used to facilitate record keeping (such as in credit bureaus). After each item in your list, tell why the specific application *is* or *is not* a legitimate intrusion on a person's privacy.

2. Are there certain things about a person's life that *should be* reserved to him or her personally, under any circumstances? If so, what are they?

3. Resolved: "The loss of privacy in our modern lives is largely a result of developments ('progress') in science and technology." Present arguments either for or against this proposition.

4. The introduction to this case argues that poor people should expect to give up more of their privacy than rich people. That is almost certainly true in the United States. Do you agree with this argument? Why or why not?

5. Government is usually thought of as the major protector of individual human rights. Yet *some* government agencies are more likely than others to invade one's personal privacy, by both legal and illegal means. Find some specific examples of this fact from events in the United States in the past ten years. *Should* the government be the primary protector of our privacy? Why or why not? If you say "yes" to this question, what should be done about agencies like the FBI and CIA that systematically interfere with our privacy? If you say "no," who *should be* the guardian of our privacy?

6. Resolved: "Since most information in data banks gets there when people voluntarily give that information away, the dangers of computerization in taking away our privacy are largely imaginary." Argue this position either pro or con.

Computer banks are not the only way in which our privacy may be invaded by scientific and technological devices. The following questions deal with some of these devices.

7. Scientific and technological devices have now been developed that make it possible to observe or listen to individuals without being physically present. Find out about some of these devices and the circumstances under which they might be used.

8. "Bugging" of telephones has been enormously useful in collecting information with which to indict, prosecute, and convict criminals who might otherwise not have been caught. Does this justify the extended use of "bugging" in criminal investigations? Explain your answer. What limitations should be applied to "bugging" operations?

9. Make a list of as many ways as possible that electronic surveillance might provide person A with information she needs about person B. In which of these cases do you think electronic surveillance is permissible? In which cases is it not? Explain how you made your decision in each case.

10. It is now technically possible to implant a tiny radio-transmitting unit into a person's body so that that person's movements can be known at all times. Why would this be or not be a good method for keeping track of parolees and other criminals? [Note: A proposal of this kind was actually submitted to President Nixon in the early 1970s.]

11. Considerable damage has been done to the boys' locker room of the gymnasium at Wilson High School. The principal has ordered the installation of a remote-controlled television camera to keep an eye on the locker room when the gym teacher is not present. Is this a good or bad solution to the problem? Explain your answer. [Note: Systems of this kind have been tried out in some schools.]

Background Reading List

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Topic twelve
Not enough space for everyone? Land use

Introduction

What use shall we make of the Earth's lands? Few questions are as fundamental for human societies at the close of the twentieth century as this one. We may be talking about tropical rainforests in Brazil, the Sanhel region of North Africa, the Gulf coastline of Florida, the virgin glaciers of the Antarctic, or national parks in the American West. The basic question remains the same: to what extent (if at all) should humans alter natural conditions in order to have more space for housing, agriculture, or resource exploitation?

The issue of land use is a fairly recent one. Americans of the eighteenth century would probably have been surprised and amused to hear that there was a "land shortage." Fewer than ten million souls occupied nearly a whole continent. Who could think of humans as a threat to the natural landscape?

But times have changed. A number of factors now contribute to a growing concern about the threat humans pose to the land. In the first place, there are simply many more people. As populations skyrocket, pressures increase for the conversion of natural areas to farms and range land. This is especially true in less industrialized nations. In some parts of Africa, for example, these pressures are driving many species of wild animals to the brink of extinction.

In other places it is not so much a battle of survival as an expression of personal preference. Anyone who has flown over the American West, for example, would be impressed by the vast areas of undeveloped land. It's hard to argue that we don't have enough space for new housing or agriculture. The problem is that so many people want to live in a particular environment, namely, near the water. Thus, demands for housing along the

oceans, the Great Lakes, and the Gulf of Mexico far exceed the land available. Currently, three-quarters of all Americans live within fifty miles of one of these great bodies of water.

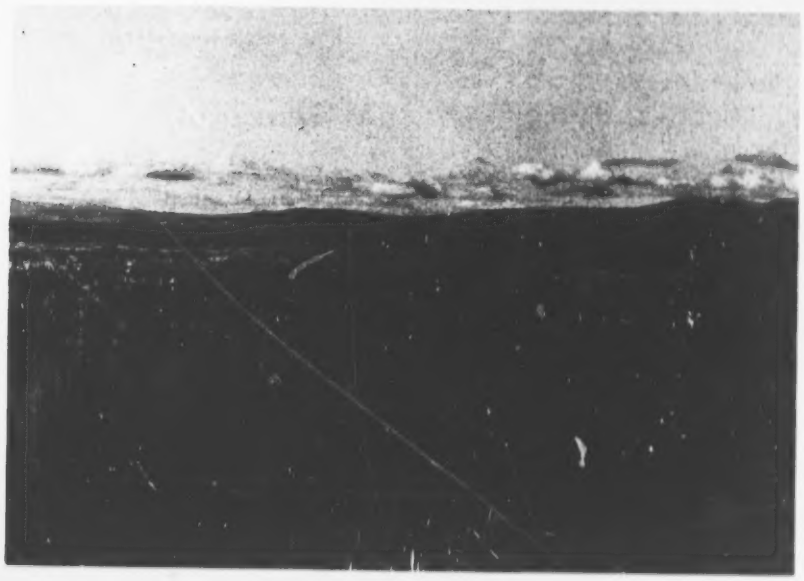
Pressures on the natural environment are increasing also because of our accelerated search for minerals. Mining coal, iron, copper, oil, sulfur, potash, and other minerals has always scarred the land. But the problem is becoming more serious today. As we use ores that are poorer in the mineral we want, we have to dig up more and more of the ore. Also, we're finding it necessary to begin searching in regions where mining has never been done before: the Antarctic, ocean bottoms, and national parks, for example. In each of these cases, questions of environmental damage and the best use of our land areas have been raised.

A fourth factor that makes land use an issue today is technology. Humans could not make an enormous impact on the landscape working with pick and shovel. But modern land-moving equipment has changed that. Power shovels used in strip mining, for example, can move thirty tons of earth in a single scoop. Atomic weapons have been suggested as another dramatic way of moving huge volumes of earth. With tools like these, the human impact on the environment can be profound. The case studies that follow focus on three widely different aspects of this issue.

Case Study #1: Changing the shoreline

The J.P. Barnum Construction Company has decided to build a retirement community along the southern edge of the Florida panhandle. At present, the region is almost total wilderness. There are no roads leading to the coastal area, and the nearest town of any size is fifty miles away. The proposed land development lies within the Owahachee Indian Reservation, but the Owahachee council has agreed to sell off 200 acres of their land for $20 million. They have pointed out, however, that the land is probably not satisfactory for building since it is quite low. Much of it is swampy and, especially along the coast, almost underwater at high tide.

J.P. Barnum has done a thorough study of the area and is aware of the construction problems. But he believes that the land can be salvaged for building by constructing a twenty-kilometer (twelve-mile)-long dike at the shoreline, pumping out much of the water now in swampy areas, and bringing in about thirty cubic kilometers of solid fill. By sinking heavy piers deep into the ground, he believes he can construct a platform sturdy enough to hold his buildings. In any case, demand for waterfront homes is so great that he has already obtained over $10 million in advance land sales, options, and down payments on condominiums. He has appeared, therefore, before the Cass County Commission with his plans for the project, seeking approval for construction.



This marshland, inhabited by a large colony of muskrats, could be put to a number of uses. List as many uses as you can think of. Which of the uses that you list might be most productive? Why? Should any of the uses that you list be prohibited? Why or why not? (photo courtesy of U.S. Department of the Interior; Sport Fisheries & Wildlife)

The Buck Stops Here

Have various members of your class play the following roles:

1. President of the Barnum Construction Company
2. Members of the Cass County Commission

3. Representatives of the local Audubon Society and Sierra Club chapters

When everyone has had an opportunity to develop an argument for or against the project, hold a mock commission hearing on the issue and have the members of the commission try to reach a decision one way or the other on the project.

Additional Questions

1. As a consulting ecologist, what biological information about the area would you want to have before making a recommendation to the county commission as to whether or not it should approve the Barnum request?

2. What geological and/or geographical information should the commission take into consideration before making a decision?

3. List as many ways as you can think of in which this project might produce environmental or ecological damage to the land area in and near Cass County.

4. Suppose the setting of this project had been the Puget Sound area of Washington State. How, if at all, would that affect your answers to Questions 1-3 above?

5. What social, political, economic, or other factors might be taken into consideration along with the scientific factors you identified in Questions 1-3 above?

6. See what you can find out about the effect of landfill and housing construction that has already been completed in the San Francisco Bay area, along the New Jersey coast, in Florida, or along any other coastline. What have been the positive and negative effects of projects like these?

7. What specific things can be done by developers to protect the area in which they are building from unnecessary ecological damage? Can *anything* be done? Explain your answer fully.

Case Study #2: Development in the tropics

The Katakana Tropical Forest in Guyana lies fifty kilometers (thirty-one miles) from the Pacific Ocean at an altitude of about 100 meters (325 feet). It covers an area of about 50,000 kilometers (31,000 square miles) and is thought to be one of the most productive forest areas in all of South America. A desperately poor nation, Guyana is now considering the development of a large agricultural station in the Katakana. Government officials hope that farms and range areas established here would increase the nation's food supply by as much as 35 percent.

At present there are six small primitive tribes living in the Katakana. They survive by hunting in the forest and fishing in the Mbatku River that runs through the forest. None of the tribes appears likely to survive very long anyway. Since they were first discovered a century ago, their total population has dropped from about 12,000 to less than 1,000 today.

There is some concern among biologists of other nations about the loss of certain species of plants and animals that are found only in the Katakana. The Guyanan government acknowledges this possibility, but feels it is a price that must be paid to increase the quality of life among the human population of Guyana.

The Guyanan government has limited financial resources and will not be able to provide the $200 million needed to begin this project. It has, therefore, submitted a request for a grant and loan for this amount to the International Bank. They are requesting a developmental grant of $50 million and a loan of $150 million at 4.37 percent per year.

The Buck Stops Here

As a member of the board of directors of the International Bank, how would you respond to this request? Choose any one of the nations listed below to represent and then hold a board meeting with other members of the class representing other nations.

Japan (two members)
Tanzania (one member)
Iraq (one member)
France (one member)
United States (four members)
Saudi Arabia (two members)
Venezuela (one member)

Additional Questions

1. The Guyanan government has privately decided to go to a private developer if the bank refuses its requests. Three major multinational corporations have already expressed interest in helping with this project. In this case the developer would have the right to use 25 percent of the new agricultural land for the planting of coffee trees. Income from the export of the coffee would provide a financial return to the developer for its initial investment in the project. Had you known about this arrangement, would you

have decided differently with respect to the bank's involvement? Why or why not?

2. As a member of the Guyanan government, what reasons might you have for opposing this project?

3. As an average citizen of the United States, what reasons might you have for supporting this project? For supporting the grant and loan request? For opposing each?

4. The conversion of tropical forestland to more "productive" use (highways, farms, ranches, etc.) has already been attempted in some countries. See what you can find out about these experiences. Use both the *Background Reading List* and other readings you may be able to locate.

Case Study #3: How shall we use government lands?

Amos J. Rutledge has been nominated to be Secretary for Environmental Affairs by Governor Harrison Stirdavant. The House Committee on Environmental Issues is currently holding hearings on Mr. Rutledge's nomination. During hearings of this kind, a variety of issues may arise. Questions are likely to be asked about the nominee's previous experience, his qualifications for the job, his financial holdings, and so on. Of major interest is likely to be Mr. Rutledge's philosophy about land use. The state government currently owns 44 percent of all land in the state. Many demands are being placed on the state for the commercial development of this land. Surveys suggest that large reserves of natural gas, uranium, copper, molybdenum, and other minerals may be located on state land.

For many years the state has followed a policy of preserving land in state forests, state parks, and state recreational areas. At present, 90 percent of all state-owned land has been set aside under one of these designations. Mining and other commercial operations are currently prohibited on these lands except under the most unusual circumstances. (The state has leased about 2 percent of its lands under the "unusual circumstance" provision.)

Mr. Rutledge is well known to oppose this policy. His argument is that our modern economy depends heavily on a reliable supply of natural resources: water, fossil fuels, metals, and other minerals. As current sources of these materials are depleted, we must search more aggressively for new sources. Leaving state parks, forests, and recreation areas unexploited is a luxury we simply can't afford, he believes.

To this extent, Mr. Rutledge's position is not particularly unusual. Many officials today would agree with him. The problem is that an important factor in determining Mr. Rutledge's philosophy are his religious beliefs. In earlier interviews, Mr. Rutledge cited the Biblical injuction to "go forth and subdue the earth," a charge he regards as his responsibility to carry out. His denominational teachings include the belief that the end of the world is near at hand . . . within a time that is measured in years or decades rather than centuries. Under these circumstances, Rutledge believes, the idea of preserving our lands for future generations is not reasonable. There probably won't be many "future generations." Our goal right now ought to be finding, taking, and using the earth's resources to the fullest extent possible. As one example, Mr. Rutledge has previously recommended that the amount of state land set aside for recreational uses be reduced by 35 percent. Oil and mineral corporations should be encouraged to purchase leases on portions of land previously set aside for state parks, forests, and recreational areas. These leases can be sold at considerable profit to the state, and will assure that whatever mineral resources are present in the state will be quickly and efficiently exploited. Rutledge argues that this is the kind of economic and political policy which the state should enthusiastically pursue.

The Buck Stops Here

Assume that you are a member of the House Committee on Environmental Issues. You understand that if Rutledge is confirmed, he will be in a position to put the philosophy outlined above into practice. Would you vote for his confirmation? Why or why not?

Additional Questions

1. An important concern of the Reagan administration, which took office in 1980, was the problem of "strategic minerals." Find out what these "strategic minerals" are, why they are considered to be "strategic" and how they are used by the United States.

2. Many of the shortages "discovered" by the government in the early 1980s had actually existed for thirty years or more. Of what significance was the fairly sudden emphasis on this issue by the Reagan administration?

3. A special interest expressed by Mr. Rutledge in earlier

testimony concerned the extended use of strip (or surface) mining in state parks. His argument is that the vast majority of Americans never see remote areas of their own state parks. So what harm would there be in allowing mining in these regions? How do you feel about this argument?

4. Mr. Rutledge's plans for land use are obviously influenced by his religious beliefs. Is this:
   a. common among government officials?
   b. legal (constitutional)?
   c. desirable?
   d. acceptable (to *you*)?

   Explain your answer to each of these questions.

5. You may disagree with the specific strategies of Mr. Rutledge or any other government official. But it is probably true that our supplies of many important minerals will be decreasing over the long run. Are there *any* circumstances under which strip mining in national parks or forests would be acceptable? What alternative solutions are there to this problem?

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Topic thirteen
Who owns the oceans? Our maritime resources

Introduction

Who owns the oceans? If that strikes you as a pretty dumb question, you've got a lot of company! Throughout most of history, the Seven Seas have generally been regarded as "no-man's land." Free access to the two-thirds of our globe that makes up the high seas—for the purpose of exploration, transportation, and fishing—has usually been taken for granted. A nation might defend its land borders vigorously against foreigners. But it just didn't much care what happened three miles or so out into the ocean from its beaches.

Only in very recent times, in fact, have most nations either given serious thought to or taken action concerning who "owns" their offshore waters, the land and resources beneath them, and the fish populations that live in them. When that question *has* arisen, it's been answered very differently by different countries: Australia claims a three-mile territorial limit, but a twelve-mile limit for economic rights; Mexico claims a twelve-mile limit for both territorial and economic purposes; Costa Rica claims twelve miles for territorial, but 200 miles for economic exploitation; Nigeria claims thirty miles for each; and Brazil, Argentina, Chile, Panama, Peru, and most other South and Central American countries claim 200-mile limits for both purposes. In 1977, the United States Congress changed its historical claim of a three-mile limit to a new 200-mile zone for economic utilization.

In 1973, the United Nations decided to try resolving these differences of opinion about the use of the oceans. They convened the Law of the Sea Conference, which continued to meet over the next nine years. In 1982, a final draft of proposed guidelines was presented to the Conference and signed by 117 nations.

The Law of the Sea Treaty provided for a 12-mile limit for a nation's sovereign rights and a 200-mile limit for natural resources and certain economic activities. You can find a brief and very useful summary of the Treaty's major provisions in the 1984 *Encyclopedia Britannica* Book of the Year, page 480.

Unfortunately, the United States and about twenty other (primarily developed, industrialized) nations did *not* sign the treaty. Thus, many of the issues which prompted the United Nations to call the Conference in the first place have still not been resolved.

Differences of opinion as to who owns how much of which ocean are hardly an academic matter. Iceland and Great Britain have been quarreling for years about fishing rights in the waters off Iceland. Iceland has been demanding exclusive rights out to a distance of fifty miles. But Great Britain has applied its own criterion (six miles from their coast) to the Icelandic situation. The "quarrel" has become fairly violent. It has taken the form of net-cutting and gunboat-firings, usually by ships from Iceland. For the smaller nation the result of this battle may literally be a matter of economic life and death. A similar mini-war goes on off the coast of Ecuador. There American tuna fishermen who invade that nation's self-proclaimed 200-mile limit are subject to capture, forcible towing to a local port, and fines in the thousands of dollars per boat. Russian trawlers off the New England coast have encountered the same problem since Congress imposed the 200-mile limit.

Fishing rights are only one of the issues centering on ocean rights. At that, it seems a somewhat strange issue. The thought that there might not be enough fish for a nation—or for all the world's nations in fact—would probably have seemed laughable a century ago, a generation ago, or even a decade ago. Certainly

A Bureau of Mines engineer prepares to lower an experimental ocean-floor drilling rig. In what ways (if any) is oceanographic research an important part of the nation's economic, political, and social policies? Is the support of oceanographic research a legitimate responsibility of the federal government? Why or why not? (photo courtesy of U.S. **Bureau of Mines)**

logic tells us that the millions of cubic miles of ocean contain far more fish than humans could possibly consume.

This is only an example of our longstanding naive confidence in the seas' unlimited ability to do anything and everything we ask of them. The fallacy of that confidence is now becoming more apparent with each passing year and each new fishing season. Modern fishing equipment and techniques are decimating some areas at a totally unexpected rate. In 1960, 110,000 tons of haddock were brought in from Icelandic waters. In 1973, that total had dropped to 40,000 tons. The herring catch from the same region fell even more dramatically during the same period, from 750,000 tons to about 60,000 tons. By the mid-1980s, fish production by most maritime nations had continued to decrease although at a slower pace.

The same story is being repeated closer to home in New England waters. The catch of herring, cod, haddock, shellfish, and other food fish averaged about 700 million pounds a year between 1952 and 1960. About 90 percent of this was taken by United States boats. By 1969, fishing fleets from the Soviet Union *alone* took 836 million pounds compared to only 418 million pounds taken by United States boats. Two points should be noted about these figures. First, the Soviet total amounted to 50 percent of all fish taken in these waters, while United States interests accounted for only 25 percent of the total. The fishing industry in our northeastern territorial waters had become, therefore, largely a foreign business.

Secondly, the *total* tonnage of fish taken had increased by 250 percent in less than ten years. In these two points lies the source of so much uncertainty and conflict about "ownership" of the seas. First, some species of fish are being taken so rapidly that they are now threatened with extinction. At the very least, they are likely to lose all value as food fish for humans over the foreseeable future. The National Marine Fisheries Service has recommended the suspension of haddock fishing on Georges Bank off Maine because that species has been so depleted. Experts predict a similar future for cod, lobster, sea scallops, and yellow-tail flounder. And second, modern fishing systems now make it possible for *any* country to travel almost any place in the world to do its fishing.

Problems related to the fishing industry are, however, only one aspect of the overall questions of international control and use of the oceans. The exploration and development of petroleum and mineral resources present a second challenge. Again, until the last few years little research had been done on natural resources available on the ocean floor. No one knew very much about these resources. Given the abundance of oil, natural gas, and minerals on land, no one much cared. The energy crisis made us especially aware of the abundance of at least one of these resources—oil— on the continental shelves. In just the three-year period from 1969 to 1972, the worldwide production of petroleum from offshore wells increased by 53 percent, going from 6.2 to 9.5 million barrels. In 1972, there were more than 14,000 offshore wells in place in the United States alone. The total value of all petroleum recovered from the continental shelf off the United States increased sevenfold between 1970 and 1980, from $8,877,452,000 to $62,825,932,000.

Given the domestic and international state of affairs with regard to energy consumption, significant increases in offshore drilling seem an absolute certainty. The United States will hardly be alone in this trend. Similar discovery and utilization of other mineral resources are almost certainly a part also of our near or longer-range mining plans. Among the best known and studied of these resources are manganese-rich nodules that cover certain portions of the ocean floor. As land-based sources of such minerals are used up, the ocean becomes a major alternative source of copper, silver, manganese, and other crucial metals.

Yet a third aspect of our concern about ownership of the oceans is related to that always-present modern problem of pollution. For centuries, the seas have been regarded as the handiest and greatest of human garbage dumps. An endless variety of waste products—from a city's garbage to excess oil from a mammoth tanker—was simply abandoned at sea. At one time the world's population was relatively small and our wastes were simple (i.e., biodegradable) and limited. Then, the ocean could handle this role. But growth and "progress" have changed all that. Today, observers on all the Seven Seas have reported finding examples

of wastes—from clumps of oil to old plastic bottles—floating in the most remote parts of the world.

The future promises even more. There will be more not only in terms of quantity, but also in terms of products that present new and poorly understood problems of waste disposal. The dumping of radioactive wastes and of obsolete or unwanted chemical and biological weapons provide two dramatic examples. What the ultimate fate of all these wastes will be and who will be responsible for them is yet one more issue in the question of the management of the oceans.

Finally, there is the question of oceanographic research. The solutions to all of the problems mentioned here probably can be found only through a better understanding of the world's oceans. It's nothing short of remarkable that we still know far less about our own oceans than we do about the moon or even Mars. It would seem that every nation in the world would welcome the opportunity to have oceanographic research vessels studying its own coastal waters. But here too there is controversy. Some smaller nations in particular prefer not to have foreign vesssels "snooping" in their territorial waters. Even our own "enlightened" United States government has drastically cut back on funds for oceanographic research in the past. Economy measures by the Nixon administration in 1973, for example, forced the closing of three marine laboratories operated by the National Ocean and Atmospheric Administration (NOAA), in spite of the fact that the agency had been established only three years earlier to carry out just this type of work!

Thus, a difficult dilemma exists. Oceanographic problems are becoming more complex and ocean resources are becoming more essential to almost every nation. But at the same time international confusion about control of the oceans increases. Some poorer nations (especially South and Central American ones), for whom fishing is a crucial industry, are demanding a 200-mile limit. Other island nations, like the Philippines, Indonesia, and Fiji, claim all the water in and around their land area. Still other nations, like Egypt and Malaysia, are demanding sovereignty over the bodies of water lying next to their lands.

While control of adjacent ocean waters is not as crucial to their very survival, larger nations like the United States, Japan, and the Soviet Union are still very much concerned about territorial rights. Acting selflessly and going back to a three- or twelve-mile limit for ourselves while recognizing a 200-mile limit for less-developed nations, for example, might be a generous economic action for the United States to take. But it would probably mean the end of our domestic fishing industry. It would also be politically dangerous in states like Maine and Massachusetts where fishing is still a major industry.

Staying with a 200-mile limit for ourselves, however, might well set off an international race in which every nation would "grab" as much of the oceans as it thought it could get away with. If that happened, more than a third of the world's ocean beds might come under the control of individual nations. The final consequences of such nationalization of the oceans would probably be impossible to predict, but horrible to imagine.

Case Study: Law of the Sea

The Government of Panama has decided on a new policy regarding the use of the oceans. Simply stated, it has agreed to recognize a territorial limit of twelve miles of all "developed" nations of the world (e.g., the United States and Japan), while adopting a 200-mile territorial limit for itself. It has already notified its fishing fleets of the decision and told them that they can make their excursions into any waters up to twelve miles from the United States coast. In addition, it has chartered a National Petroleum Corporation (NPC) to organize drilling expeditions on the continental shelf twenty-three miles south of New Orleans. NPC has received substantial financial backing from three of the largest petroleum producing corporations in the world. Initial studies have shown the existence of large pockets of oil in the area and geologists predict a large probability of success for any wells drilled there.

The United States Ambassador to Panama has strongly objected to this new policy, pointing out that it is discriminatory. "How can the government of Panama apply one standard to its own shores (the 200-mile limit)," he asks, "while recognizing a quite different one for certain other nations? Besides, how can it justify drilling oil in a part of the ocean only a few miles from a foreign (United States) coast, but thousands of miles from its own?"

In its reply to the Ambassador's protest, the Panamanians have made two points which they claim are "obvious and simple." In the first place, they point out, the United States is a great international power with enormous natural resources. Panama, on the other hand, is a tiny country with a low standard of living and virtually no natural resources of its own. It's only just that whatever resources the open seas have to offer should be equally available to all countries of the world. With its traditional sense of equal opportunity and fair play for all, the United States should certainly be willing to allow a tiny nation like Panama a

chance to fish and explore for oil wherever it can. Besides, since there is no petroleum in Panama itself, this is virtually the only way it will ever have of becoming self-sufficient in that resource.

Rep. Trudy Fahrenskware (D-New Mexico) agrees with the Panamanians. She has introduced a bill in the House of Representatives calling for a relaxation of the United States's 200-mile limit in the case of Panama and "all other non-industrialized nations with similar economic problems."

The Buck Stops Here

As a member of the United States Congress, what would be your position on Rep. Fahrenskware's bill? Explain why you would or would not support the bill. Outline any changes that could be made that would make the bill more acceptable to you.

Additional Questions

1. How realistic is this problem? That is, what reasons might there be for thinking that a situation like this could or could not arise?

2. What additional arguments could the United States have offered in opposition to the Panamanian's position? What additional arguments do the Panamanians have?

3. Having heard both sides of the argument, which spokesperson do you think is "right"? Do you see any way(s) in which a compromise might be worked out?

4. What complications, if any, might arise when Panama tries to enforce its new policy with respect to its other neighbors? With respect to more distant foreign countries?

5. Since different nations have different needs, different natural resources, different levels of development, and so on, are there *any* general principles which could be established with regard to ownership of the oceans?

6. Suppose that no international agreements are reached in the next five to ten years. What problems among nations over the use of ocean resources do you think might develop?

7. What connection, if any, do you see among the four major facts of the "ocean problem," i.e., among the fishing industry, mining for minerals, pollution of the seas, and oceanographic research?

8. In 1969, the National Ocean and Atmospheric Administration was established by the Nixon administration as an "umbrella" agency to deal with all aspects of marine and atmospheric problems. See what you can find out about the successes and failures of that agency in general and especially with respect to this problem.

9. Over-fishing along the western coast of South America has so seriously depleted the supply of anchovies there that harvesting of this fish there has all but been discontinued. This event has enormous significance for the world's food economy even though the anchovy is only a minor food in itself. Explain why this is so.

10. The Panamanian plan could have enormous economic significance for the three petroleum corporations through which it is working to develop offshore wells. How does this fact affect, if at all, any action the United States Congress might take on Rep. Fahrenskware's bill?

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Topic fourteen Groundwater pollution

Introduction

". . . it is our major [environmental] bugaboo."
". . . one of our nation's highest priorities."
". . . the main environmental challenge of the coming decade."

What environmental issue is provoking comments such as these? The problem may be one about which you have heard relatively little: the contamination of our groundwater. The term *groundwater* refers to water found in permeable layers of rock (called *aquifers*) below the earth's surface. Scientists believe that aquifers may contain about five percent of all water moving through the earth's hydrologic cycle (that is, water on, in, and above the earth's crust).

Normally, precipitation (rain, snow, sleet, hail, etc.) that falls to the earth sinks into the ground or runs off into rivers, lakes, streams, and the oceans. Water that seeps into the ground may move slowly through the soil and rock until it reaches a river or lake. Or it may remain trapped in an aquifer for many (dozens or hundreds of) years.

Aquifers are a particularly important source of water in regions where lakes, streams, and other surface sources of fresh water are unavailable. In these regions, wells sunk into an aquifer are the major source of water for drinking, cooling, bathing, washing, agricultural, and industrial uses. Some Midwestern and Southwestern states depend on aquifers for well over half of their water supplies.

Pollution of our groundwater supplies has been recognized as a serious environmental problem for less than a decade. Aquifers often lie hundreds of meters below the earth's surface. So the quality of water stored in them is usually difficult to determine. Contamination of an aquifer is often apparent only when wells begin to produce tainted water. Experts believe that up to 10% of all aquifers in the U.S. and Canada are now contaminated to a greater or lesser extent.

This contamination is the result of many factors: private septic systems; municipal, agricultural, and industrial wastes; community sewage treatment plants; and industrial spills; for example. As with other forms of pollution, humans have been acting as if the earth and its natural processes would take care of any wastes we wanted to dispose of. Household waste emptied into a septic tank would, we hoped and believed, return to a natural, harmless form underground. Wastes from chemical plants would also (again, a hope!) remain in the underground tanks we built for them, removing any danger they might otherwise pose for plant and animal life. Disposing of wastes underground is probably *the* classical example of "out of sight, out of mind."

This approach to waste disposal does not, however, take into consideration two factors. First, the growth of population and increase in population density in some areas means that the natural processes by which wastes are taken care of may now be inadequate. Aquifers may just be overwhelmed by the volume of wastes that have been emptied into them.

Second, the character of wastes reaching aquifers has changed. Industrial, agricultural, and municipal wastes now contain a much larger fraction of synthetic materials than has ever been the case. These synthetic materials often share too ecologically troublesome characteristics. First, they tend to be long-lived. The natural decay processes that take place underground are usually not able to degrade these synthetic wastes. Thus, they build up in and contaminate an aquifer for hundreds or

thousands of years. Also, many synthetic chemicals are harmful or toxic to humans, other animals, and/or plants.

The picture we're painting, then, is one in which our groundwater becomes increasingly contaminated by waste materials which may be harmful to life on earth, are likely to remain so for very long periods of time, and will remain for generations in the water supplies on which communities, agriculture, and industry depend.

One of the difficult questions about groundwater pollution is where responsibility lies for resolving this issue. The simplest answer may be at the source. Farms, industries, cities, and individuals will simply have to reduce the wastes they release to the environment. Yet, this solution may be naive. As with most pollution issues, the problem arises because of progress: larger towns, new chemicals, and increased production, for example. In order to cut down on pollution, therefore, we have to ask people to accept a somewhat reduced standard of living.

The alternative may be to try cleaning up aquifers after they've become contaminated. The technical problems with this approach, however, are staggering. Some authorities suggest, in fact, that removing all the contamination from an aquifer may be an impossible task.

Furthermore, no one is quite sure where responsibiity for such clean-ups lie. Do we ask communities and industries to "clean up their acts" voluntarily? Or should the federal government pass and enforce appropriate laws? Or should state governments assume this role? Or local governments?

Perhaps the most aggravating feature of this issue is the time factor. Months and years go by as we slowly recognize that this problem exists, begin to see its magnitude and implications, argue over responsibility for solving the problem, develop technologies for stopping or removing pollution, and then start to act. All the while, wastes are dumped into and onto the earth, and pollution spreads through our groundwater. Will we recognize and solve this problem before it's too late? Or will our answers come long after major portions of our aquifers have been destroyed for human use?

Case Study

The residents of Valley View have a lot to thank the PlaStix Manufacturing Company for. Ten years ago, the company built a plant in Valley View just at the moment when many citizens thought the town would die. The wheat farms which had spurred the birth and growth of Valley View and surrounding Dixon County were rapidly disappearing in the 1970s. Dozens of families were selling or losing their farmland and moving out of the area. Unemployment in Dixon County had reached 25% by the late 1970s, and residents saw no way to prevent Valley View from becoming a ghost town.

The arrival of PlaStix on the scene dramatically altered the town's economic condition. The new plant employed 350 people and, for the first time in more than a decade, promised a rosy future for the area. Appreciative townspeople carried on a "love affair" with the company for the next ten years, providing free land and special tax breaks to keep the company happy.

Now, the honeymoon seems to be over. PlaStix has requested another zoning variance which would allow them to build an addition to its existing plant. The new addition would double the size of the plant and provide an additional 300 jobs in the community.

Until recently, the idea of a bigger plant and more jobs would have produced nothing but joy in Valley View. Even now, some members of the community are enthusiastic about the company's request. "Once again PlaStix has laid a golden egg for our community," Mayor Harley Dotful has said. "More jobs and expanded production at the plant can bring nothing but prosperity and a better standard of living to all residents of Dixon County."

The mayor's ardor is not shared by everyone, however. The problem seems to be a growing concern among Valley View and Dixon County residents about the quality of their groundwater. A number of families have reported that their drinking water (taken from wells) has a bad taste, color, and odor.

Officials at Likabul Memorial Hosptial have reported an increase of 23.8% over the last five years in outpatients treated for dizziness, nausea, lethargy, and other conditions which health workers think "may be the result of drinking tainted water." Dr. Paul Bear, County Public Health Officer, has issued numerous warnings about contaminated drinking water in the past and now warns that maintaining a safe water supply may soon be the county's number one public health priority.

The issue of groundwater contamination has become enmeshed with PlaStix's request because of the enormous volume of wastes produced by the plant each year. Organics and strong acids constitute the major portion of these wastes. Most are toxic or, at least, harmful to the health of humans, other animals, and plants.

To this point, both company and community have been reasonably satisfied with the company's waste disposal system. The company has constructed a very large

underground vault, 100 meters below the earth's surface, with concrete walls two meters thick. The company has assured the town that the vault will contain all their wastes until they have lost their toxicity. Construction of the new addition will require a second underground vault to hold additional wastes. The company guarantees that the second vault will continue its flawless safety record.

The company and some town officials reject claims that the existing waste vault has leaked and/or is contributing to the town's groundwater problem. They suggest that contamination—if it really does exist—comes from some other source. More likely, they argue, people are imagining a change in water quality or have decided to use this issue as an argument against the company's plans for expansion. In any case, they say that refusal of their plans will cause them to close the Valley View plant and move their operations to South Korea, where groundwater problems are not an issue.

The Buck Stops Here

The mayor has asked you to serve as a member of the Special Advisory Committee to study the PlaStix request. Read as much as you can about the current status of groundwater contamination. Examine carefully the information and opinions presented in the Case Study. Then, working with other students in the class, prepare a recommendation for the Town Council about the PlaStix request.

Additional Questions

1. By what natural processes are underground wastes converted to harmless forms?

2. Draw a diagram that illustrates the earth's hydrologic cycle. Show where and how underground water is a part of this cycle.

3. How important are groundwater resources in *your* community? What is the quality of these resources? What sources, if any, presently threaten these resources?

4. Who should have primary responsibility for legislating and enforcing rules about groundwater contamination? Why?

5. What methods are available for cleaning up an aquifer that has become polluted?

6. For the vast majority of chemicals which scientists consider dangerous to humans, we have only studies on laboratory animals. Do such studies provide adequate data for the mounting concern about health issues resulting from groundwater pollution?

7. What is a "water table"? Of what relevance is the concept of a water table to the issue of groundwater pollution?

8. Select any substance which you know contributes to the contamination of groundwater. Some possibilities include (1) radioactive wastes, (2) carbon tetrachloride, (3) salt (i.e, sodium chloride), (4) lead, and (5) sulfuric acid (H_2SO_4). Then find out as much as you can about (1) possible sources, (2) pathway by which the substance reaches an aquifer, (3) potential threat, if any, to humans, other animals, and plants, and (4) methods for removing the pollutant from groundwater.

Additional Readings

Burmaster, David E., and Robert H. Harris. "Groundwater Contamination: An Emerging Threat." *Technology Review*, July 1982, pp. 50–60. *One of the earliest articles to look at this issue in depth.*

Carey, J. "Is It Safe to Drink?" *National Wildlife*, February 1984, pp. 14–17. *Part of a special report on water quality in the United States.*

Edwards, J.W. "Trouble in Oiled Waters." *National Wildlife*, October–November 1985, pp. 28–29. *Problems created by petroleum leaking from underground tanks and contaminating groundwater.*

Ember, Lois R. "Stringfellow Clean-up Mishaps Show Need to Alter Superfund Law," *Chemical and Engineering News*, May 27, 1985, pp. 11–21. *Laws designed to protect the nation's groundwaters appear not to be working very well.*

Janigan, Mary. "The Trail of a Toxic Disaster." *Maclean's*, April 29, 1985, pp. 14–17. *Story of a particular event in Canada with a discussion of the broader problems such events cause.*

Maranto, Gina. "The Creeping Poison Underground." *Discover*, February 1985, pp. 74–78. *A good overall introduction to this problem.*

Marshall E. "Selenium Poisons Refuge: California Politics." *Science*, July 12, 1985, pp. 144–146. *A good discussion of the pollution of the Kesterson refuge in California, an extremely important and valuable*

case study of groundwater pollution.

Parfit, Michael. "Groundwater Proves a Hidden Element Whose Time Has Come." *Smithsonian*, March 1983, pp. 50–61. *A summary of the growing significance of groundwater, with some hints of the potential crisis to come.*

Piper, D. and F. Ladd. "Toxics on Tap." *Sierra*, July–August 1985, pp. 56–58+. *Groundwater problems created by chemicals seeping into the earth.*

Protecting the Nation's Groundwater from Contamination, report by the Office of Technology Assessment, reviewed by E. Phillip LeVeen in *Environment*, May 1985, pp. 25–27. *An insightful and valuable review of this very important document from the U.S. government.*

Tangley, Laura. "Groundwater Contamination: Local Problems Become National Issue." *BioScience*, March 1984, pp. 142–146+. *A survey of the current status of groundwater pollution.*

Topic fifteen
Avoiding nuclear conflict

Introduction

How best can we end the threat of nuclear war? That question has been on the minds of people throughout the world since the first nuclear bombs fell on Hiroshima and Nagasaki in August 1945. Policymakers and concerned citizens have usually taken one of two positions on the question.

One possibility is to continue the development and construction of ever-more-powerful nuclear weapons. This strength of weaponry will, some believe, prevent an enemy from attacking our country. The enemy will realize that any attack which it launches will be met by a response by our own weapons, resulting in their destruction also.

This approach to keeping the peace has been called Mutually Assured Destruction (M.A.D.) Supporters of M.A.D. believe that a war with nuclear weapons would be so terrible that no nation could conceivably start such a conflict.

The second approach to keeping the peace is to stop production of nuclear weapons and to begin reducing the number of weapons held by all nations. Those who hold this view argue that the only way to avoid a nuclear war is to eliminate the weapons with which such a war could be waged. They search for a way to encourage disarmament by both the United States and the Soviet Union that will increase trust and confidence in the other nation and decrease the threat of nuclear attack.

A third possible approach to keeping the peace has received less attention in the United States. That approach involves the construction of a comprehensive, infallible system of *defense* for our nation and its allies. The argument for this approach is that the presence of a reliable defense system would convince an enemy that they would

have little chance of initiating a successful nuclear attack. They would realize that our defensive system would allow a large fraction of our cities, industries, military bases, and population to survive. A rapid and effective response to such a nuclear attack would thus be possible. The enemy would have no chance, then, of winning a quick victory from a single, massive nuclear attack.

President Ronald Reagan proposed such a defensive system in a speech on March 23, 1983. He suggested that the U.S. begin research on a defensive system that would make use of the most up-to-date technology now available or in the planning stages. President Reagan's proposal became known as the Strategic Defense Initiative (SDI) or, more popularly, as the "Star Wars" project.

Funding for SDI research first appeared in the 1984 budget and grew from $900,000,000 in that year to $1.4 billion in 1985 to about $3.5 billion in 1986. Estimates are for an expenditure of a $26 billion in the first five years of SDI research. The total cost of putting a complete SDI system in space by the end of this century is almost impossible to estimate. But a figure between $1 trillion and $2 trillion seems a reasonable guess to both supporters and opponents of the plan.

What kind of a defensive system will this money buy? SDI is a four-tiered program designed to detect and destroy an enemy rocket attack at any one (or all) of four points: (1) during the boost phase; (2) during the post-boost phase; (3) during the mid-course phase; and (4) during the terminal phase.

A variety of weapons can be used at each of these phases. For example, a free-electron laser located on the earth could generate very high energy beams which could be reflected off mirrors orbiting in space. The reflected beams could be directed at enemy rockets during their boost stage, at which point they are easiest to detect.

Proponents of SDI acknowledge that development of a defensive system will be very difficult and expensive. Yet, they believe that it can be done. Given the time, money, and personnel, they say, a complete, reliable system can be produced. Many of the components needed for SDI already exist in a primitive form or are under study.

Critics disagree. They see a number of problems with the SDI concept. They point out, first of all, that any defensive system will contain components that can also be used offensively. This means that SDI might not only be viewed as an *offensive* threat by an enemy, but it might also violate some of the weapons treaties we have signed—often after a great deal of debate and compromise—with the Soviets. Although these treaties have clearly not ended the nuclear arms race, they have proved to be important steps in that direction.

A second objection centers on the cost of the SDI project. In an era when social programs are being cut back and the nation's budgetary deficit is a major source of concern, the billions of dollars needed for SDI appear to be an unreasonable expense, some feel.

Critics also believe that SDI wil heat up, not cool off, the arms race, and will make nuclear conflict more, not less, likely. The argument is that construction of an SDI will encourage the Soviets to design and build more sophisticated weapons that will be able to penetrate our defensive system. Or they will begin work on an SDI-like system of their own. Either move would probably be followed by a response by the U.S.: improving our own SDI and/or building more and better offensive weapons.

Probably the greatest concern about SDI is that, technically, it just won't work. Opponents say that the program envisioned by President Reagan is so complex that failures are almost certain to occur. Even if SDI could be made 99% effective, enough nuclear weapons (one percent or about 100 weapons) could get through our shield to cause serious damage to the U.S. and its allies. And many scientists view a 99% reliability as a wildly optimistic estimate of SDI's efficiency. They believe that a 50–90% efficiency is a more realistic estimate.

Case Study

President Monaghan has just presented her budget for the coming fiscal year. Included in her requests is an item in the amount of $12.8 billion for additional research on the SDI program. At this point, scientists have been working on SDI for five years. They report that "very real progress" is being made, but that no single component of the system has yet been completely developed or tested. They suggest that field testing of various components could begin in about two years, with final tests of a complete system about eight years from now.

The Buck Stops Here

You are a member of the House committee investigating this part of the president's budget. One meeting of the committee has been set aside to hear the pros and cons of the SDI budget request. Decide whether you would favor or oppose this budget item. Then, prepare a one-minute talk in which you state, explain, and defend your position. Be prepared to debate with and against other class members who have similar or opposing views.

Additional Questions

1. What is your position on the fundamental issue in this case

study, namely that (1) the more weapons we have and the more powerful they are, the better our chances of preventing another war; or (2) the construction of new and better weapons can ultimately only lead to war?

2. The debate over SDI involves a number of factors: social, ethical, economic, and technical. List at least one argument in each of these categories *for* and one argument *against* the development of SDI.

3. Select any one of the weapons which is likely to make up part of the SDI system and find out as much as you can about (1) the way the weapon works and (2) its advantages and disadvantages.

4. Cost is an important consideration in the SDI proposal. Why? Should (or can) any effort be made to keep these costs within some limits? Why (and how) or why not?

5. Opponents of SDI often state their case in technical terms: The system just won't work, they say. Suppose proponents could show that this argument is wrong and that the system *can* be made to work. How would this turn of events affect opposition to SDI? Try to answer this question from the opponents' own comments. Try to answer *for yourself*.

6. Suppose that SDI could be shown to reduce the number of fatalities from a nuclear strike from 100 million to 30 million Americans and Canadians. Would this make the system desirable? Explain your answer.

7. How are offensive nuclear weapons different from defensive nuclear weapons? On which of these should the U.S. and its allies place its emphasis for research and development? Why?

8. Resolved: Placing weapons of any kind into space is a step which the nations of the world simply cannot afford to take. Argue for or against this proposition.

9. In what ways is the problem of destroying an enemy attack different for each of the four phases through which it passes (see page 179)?

10. Should the SDI decision be a matter of concern to high school students *today* (as you read this book)? To college students? Explain your answers.

11. Suppose that five years from the time of this case study, President Monaghan's successor makes exactly the same report on the status of SDI as that provided in this case study. Would your position on this issue be any different from what it is now? Why or why not?

12. SDI is obviously a complex technical question. Suppose you wanted to learn more about the technology of the system. Make a list of the places you could go to get reliable information on this topic.

Background Reading List

Arbess, Daniel. "Star Wars and Outer Space Law." *Bulletin of the Atomic Scientists*, October 1985, pp. 19–22. *The threat which SDI poses to important treaties between the Soviet Union and the United States.*

Golden, Frederick, et al. "Special Report: Star Wars." *Discover*, September 1985, pp. 28–40+. *A series of articles dealing with various aspects of the SDI proposal. Good technical background.*

Gruman, Galen. "A Flaw in the Shield?" *Science Digest*, May 1986, p. 25. *Some possible problems with the computer aspects of SDI.*

Hartung, William. "Star Wars Pork Barrel"; Peter J. Gollon. "SDI Funds Costly for Scientists"; John Kogut and Michael Weisman. "Taking the Pledge Against Star Wars"; Michael Krepon. "Dormant Threat to the ABM Treaty"; *Bulletin of the Atomic Scientists*, Janaury 1986, pp. 20–38. *A series of four articles on various aspects of SDI.*

Marsh, Gerald E. "SDI: The Stability Question." *Bulletin of the Atomic Scientists*, October 1985, pp. 23–24. *What are some possible effects of the SDI program on the political stability of the U.S. and the U.S.S.R. and on the relationship between these two nations?*

Smith, Jeffrey R. "Experts Cast Doubts on X-ray Laser." *Science*, November 8, 1985, pp. 646–648. *Authoritative opinion on an important component of SDI in late 1985. Has anything changed since this article was written?*

Thomsen, Dietrick E. "Is the Force with Lasers?" *Science News*, February 15, 1986, pp. 106–107. *"Will lasers be selected for the Strategic Defense Initiative?"*

Waldrop, M. Mitchel. "Resolving the Star Wars Software Dilemma." *Science*, May 9, 1986, pp. 710–712. *Handling all the information needed for a successful SDI program may be the most difficult problem of all.*

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part three

Science as a social institution

Topic one
Finding out what's so special: The nature of science

Introduction

The words "science" and "technology" have been used freely in the first two parts of this book. But, so far, we have not bothered to define these terms. Does this suggest that an author can write about "science" and "technology" without explaining what he or she means by these words? Are the terms familiar to and well understood by the majority of people today?

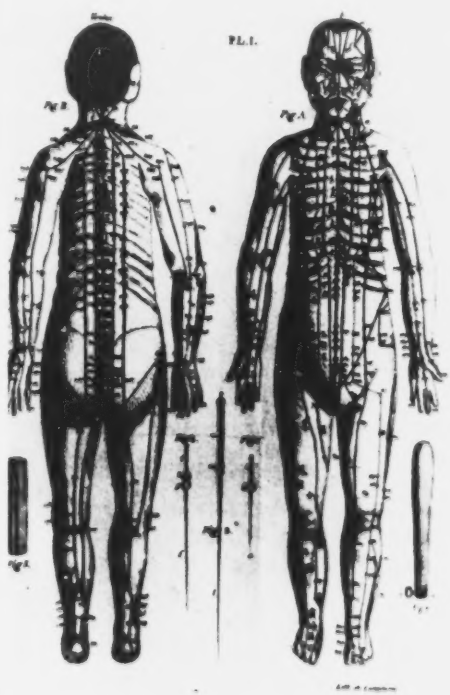
The answer is: Probably not. Most people probably believe that they know what the words "science" and "technology" mean. They see them in the newspaper and hear them on radio and television. They probably use the terms in their own writing and conversation. But chances are that most people today have an imperfect or incomplete understanding of these common words. In trying to understand the social and ethical implications of "science" and "technology," then, this might be an important problem. The purpose of this section is to help you think more clearly about this problem. As a result of doing the case studies in this section, you should develop a better understanding of the terms "science" and "technology."

Let's begin at the simplest possible level. What do you *think* these two words mean? Before going any further, write out your own definition of these two words. If you think they mean the same thing, say so and explain why you believe that. Compare your own answers with those of other students in the class. To what extent are you satisfied with your own definition? How well do others in the class agree with you and with each other?

When you've completed this exercise, find a dictionary definition for the words "science" and "technology." Are these definitions more or less satisfactory than those which you and your classmates wrote? Does the dictionary definition fit what you think of as chemistry, biology, physics, or some other science?

Don't be surprised if this exercise turns out to be more difficult than it first appears. Most of us use the terms "science" and

Acupuncture has been practiced by physicians in the Orient for centuries. No one is quite sure why the technique works. Is acupuncture a "scientific" or "nonscientific" practice? On what did you base your decision? (photo courtesy of the National Library of Medicine)



"technology" a lot . . . even though we may not bother to figure out exactly what they mean. And when we do try, we may end with definitions so general or so vague that they don't really mean very much at all!

So who really cares anyway? What difference does it make if someone can write a definition for *science* or *technology*? For one thing, there are some practical reasons. Agencies that support research are not going to give money for "scientific" research to just *any* kind of activity. There has to be something about the research that makes it "scientific." That's an important issue in the case of research on ESP, for example. People who want to study extrasensory perception would like to apply to the National *Science* Foundation for funding. But is research on ESP really a *scientific* activity? You can't answer that question until you know what *science* is.

But there is a more important reason for trying to write definitions. When we do so, we find that there are some very important and specific characteristics of the human activity we call "science." The term refers to much more than "an organized collection of facts" or some similar simplified dictionary definition. An educated citizen today really ought to know what it is that science attempts to do, what methods it uses, the assumptions under which it operates, what its limitations are, how it decides if something is "true," and how the goals and methods of science differ from those of theology, art, and other nonscientific activities.

The next set of case studies is designed to help you develop a fuller understanding of the nature of science. As you think about these problems, keep in mind the characteristics of science about which you will want to know more: the aims, methods, assumptions, nature of proof, and limitations of science, and the way these differ from nonscientific fields. The concluding activity in this series may help you put together the ideas you have developed in individual cases.

Case Study #1: Education in science

What is the aim of education? Over the centuries, many answers have been given for that question. One common theme has been to provide students with a broad liberal education. This usually means helping students understand the diversity of disciplines humans have developed for making sense out of the world we live in: history, literature, art, theology, and science for example. Each of these "ways of knowing" has some unique characteristics. There is something about the way a philosopher interprets the world which is different from the way a musician does. And the way an historian thinks and works is different from either of these. A well-educated person should be familiar, the argument goes, with a variety of these ways of knowing.

This concept is illustrated by the way school and college requirements are established. In order to be graduated, a student usually *must* have some experience in literature, some in politics, some in mathematics . . . and, of course, some in science. What this tells us is that there is something *special* about science. There is something you'll learn by studying science that you won't get from a class in art or civics or physical education. What is there that's "special" about science? What is there in science that is not to be gained from a course in any other subject?

There are two possible ways of answering that question. One is to read what experts have to say. The

selections listed in the background reading section provide a variety of arguments for the teaching of science. The selections span more than seven decades and include nearly every philosophy of science education. If you want to supplement the list, you can find "statements of purpose" for science teaching in a number of places. The introductions to science (chemistry, physics, biology) textbooks, for example, usually contain some indication of what the authors of those books see as the essential aims of science teaching.

A second way to get an answer to this question is to ask the experts directly. You're fortunate in this respect since there are experts all around you. No one will know any more about the reasons for teaching science than the physics, chemistry, biology, and earth science teachers in your own high school or college. *The Buck Stops Here* that follows will suggest a way to get and use the information you need about the role of science in education.

The Buck Stops Here

You are a member of the science faculty at your own school or college. Your department has been asked to write a brief statement on the topic: "How Science Can Contribute to the Education of a Citizen." Collect the information you need by (1) reading a variety of articles from the *Background Reading List* and/or (2) interviewing a faculty member at your school or at a school or college of your own choosing or one assigned to you by the teacher. Based on your reading and/or interview, prepare an outline showing the unique contributions of science to a person's education. Then meet with other students to prepare the brief statement described above. Make your statement concise and to the point.

Students can learn how running water changes land by reading in a textbook, seeing a film, or working with a stream table like this one. Which of these methods is the best way to learn about that concept? Explain your answer. (photo courtesy of the U.S. Department of Agriculture Soil Conservation Service)

Additional Questions

1. List five major objectives for science teaching.
2. The goals which experts set for science education are different at different times in history. What are some social, political, economic, or other conditions that influence the choice of goals in any one period?
3. Think back on the last two science classes you have taken. What do you think the aims of these two classes were? What basis do you have for the answers you give?
4. Based on the readings, discussions, and interviews you've done for this topic what are some special or unique characteristics of science as a human intellectual activity?
5. How essential do you think it is for each of the following to think carefully about the "meaning" of science ("the nature of science," or "the philosophy of science"): (a) a professional scientist, (b) a science teacher, (c) a government official, (d) an average citizen.

Background Reading List

High school

From time to time various groups of science educators publish "official" statements about the "why," the "what," and the "how" of science teaching. The first three references are among the most widely disseminated of those statements:

Nelson, Henry B., ed. *Rethinking Science Education*. The Fifty-ninth Yearbook of the National Society for the Study of Education, Part I. Chicago: University of Chicago Press, 1960, pp. 19-22, 28-30, 31-33.

_____. *Science Education in American Schools*. Forty-sixth Yearbook of the National Society for the Study of Education, Part I. Chicago: University of Chicago Press, 1947, Chapter 3.

Progressive Education Association. *Science in General Education*. New York: D. Appleton-Century Co., 1938, pp. 23-32, 56-57.

In addition to these see:

Basalla, George. "Science, Society, and Science Education." *Bulletin of the Atomic Scientists 24*, June 1968, pp. 45-48; with discussion in same, September 1968, pp. 37-39.

Bibby, Cyril. "Science: A Tool of Culture." *Saturday Review*, June 6, 1964, pp. 51-53.

Burnett, R. Will. "Educational Policy and the Science Teacher." *Science Education*, February 1945, pp. 40-44.

_____. "An Engineer and a Biologist Discuss *Education*

for all American Youth." *Science Education 29*, March 1945, pp. 93-98.

Dewey, John. "Method in Science Teaching." *General Science Quarterly I*, November 1916, pp. 3-9.

Gerard, R.W. "Science Education and the Contemporary World." *Journal of Chemical Education 20*, January 1943, pp. 45-50.

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Okey, James R. "Goals for the High School Science Curriculum." *NASSP Bulletin 56*, January 1972, pp. 57-68.

Preising, Sr. M. Joan. "Why Study Physics?" *School Science and Mathematics 44*, November 1944, pp. 708-714.

Rogers, T.H. "Supply and Demand of Technical Personnel in American Industry." *School Science and Mathematics 53*, February 1953, pp. 87-96.

Weaver, Elbert C., and Hanor A. Webb. "The Future of High School Chemistry." *Journal of Chemical Education 28*, August 1951, pp. 430-433.

College

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Cassidy, Harold G. "Physical Science for the Nonscientist and the Antiscientist." *Journal of Chemical Education 48*, April 1971, pp. 212-215.

Cohen, I. Bernard, Fletcher G. Watson. *General Education in Science*. Cambridge: Harvard University Press, 1952.

Humphreys, Lloyd G. "Education in Science for Nonscientists." *Journal of Chemical Education 48*, April 1971, pp. 216-218.

Huxley, Thomas H. *Science and Education*. New York: D. Appleton and Company, 1900.

Le Corbeiller, Philippe. "The Crisis in Science Education." *Education in the Age of Science*. New York: Basic Books, 1959, Chapter 5.

Mathewson, James H. "Science for the Citizen: An Education Problem." *Science 138*, December 1962, pp. 1375-1379 with discussion in same, 1367 and 1369, February 1963, pp. 677-682.

"The Scientist and His Education." Part III of Paul C. Obler and Herman A. Estrin, *The New Scientist*. Garden City, New York: Anchor Books and Doubleday and Company, Inc., 1962. (In this section, J. Bronowski, "The Educated Man in 1984" originally appeared in *Science 123*, April 1956, pp. 710-712; and Bentley Glass, "Liberal Education in a Scientific Age" originally appeared in *Science and Liberal Education*. Baton Rouge: Louisiana State University Press, 1958.)

Snow, Joel Alan, Don K. Price, J. Bronowski, and Polykarp Kusch. "Science and the Human Condition." *Bulletin of the Atomic Scientists 24*, October 1968, pp. 24-43.

Case Study #2: ESP: Science or magic?

Few subjects have stirred up as much controversy in the history of psychology as has the issue of extrasensory perception, ESP. Throughout history, there have been relatively large groups of people who believed in some form of mental telepathy, the ability to transmit thoughts from one person to another. At some stages, this ability was associated with magic or witchcraft. In the past few decades, however, some responsible, competent scholars have begun to study this phenomenon scientifically. A department of parapsychology at Duke University and a national journal on extrasensory perception have existed for over three decades.

Yet, parapsychologists and "establishment" scientists would probably agree that research into extrasensory perception has not yet been acknowledged as a legitimate field of scientific study. The problem seems to be that most scientists do not feel that the existence of ESP has been "proved." The whole question of the legitimacy of parapsychology as a science centers, in fact, on the issue of what scientists are willing to accept as "proof."

This question—how do we know if something is "true"—goes to the very heart of the differences among science, art, theology, and other kinds of human intellectual

activity. Which of the following, for example, is a "true" description of a tree:

The Lombardy

BY PRESTON WYLIE

Hail to thee, strong Lombardy poplar!
Nature's very own beacon;
Lighthouse atop the hill;
Strong finger, pointing to the sky,
His strong feet, firmly grasping the earth,
Slow, stately waves, its graceful torso calls
For us to see the way to God;

Hail to thee, strong Lombardy poplar!
Signpost that marks our way to our heavenly home.

Black Walnut
Juglans nigra L.

Characteristics.—Bark thick, brownish or blackish, deeply furrowed by broad, rounded ridges; heartwood rich dark brown, with thin, lighter colored sapwood; odor mild, but characteristic; diffuse-porous; growth rings narrow, terminated by narrow bands of very thick-walled, flattened wood fibers; pores somewhat larger and more conspicious in the spring wood, and for this reason often approaching characteristics of ring-porous wood; tyloses abundant; wood parencyma in numerous, very fine, concentric lines, independent of the pores; rays indistinct to microscopic; vessels without spirals.*

*From Charles Herbert Otis, *Michigan Trees*, Ann Arbor: University of Michigan Press, 1931.

Pioneer Elm

Justin Bradley

It shouldn't take long to realize that there are different kinds of "truth." Justin Bradley was certainly being honest in depicting the way he saw a tree in the drawing on page 189. So was Preston Wylie in his poem, "The Lombardy." And so was the author of the botanical definition given here. Each person is making what he sees as a "true" description of a tree. The standard for "truth" is obviously different in art, poetry, and botany.

What we'd like to determine here is what "truth" means to a scientist. How does one scientist attempt to "prove" something to another scientist? *The Buck Stops Here* that follows will help you answer that question in the controversy over extrasensory perception.

The Buck Stops Here

Members of the National Association for the Study of Parapsychology (NASP) have applied for membership in the American Association for the Advancement of Science (AAAS). AAAS currently includes many divisions corresponding to special fields of science, such as chemistry, medicine, astronomy, computer sciences, and psychology. NASP has petitioned AAAS to establish a new section for researchers in the field of extrasensory perception. As a member of the board of directors of AAAS, you will be asked to vote on this petition. Based on your readings from the *Background Reading List*, decide what position you will take on this question. A reminder: You are not deciding whether you personally believe in ESP, but whether you think research in this field is a legitimate research activity that deserves recognition as a form of *science*.

Additional Questions

1. List at least three reasons that research on ESP *can* be thought of as a form of science. List three reasons it *cannot* be.

2. To what extent do the reasons you list in Question 1 also apply to: (a) astrology, (b) witchcraft, (c) numerology?

3. What *specific* advantages accrue to an ESP researcher if he or she is accepted as "a scientist" by other scientists?

4. There are certain attitudes and behaviors that are expected of any "true" scientists. List as many of these as possible.

5. Dr. A is hiring a new faculty member for the department of chemistry at Mangold University. How does Dr. A know, when she interviews a candidate, that this candidate is really a "scientist"? [Remember: Dr. A probably does not know any of the candidates personally.]

6. Mr. B submits a research report to the *Journal of Biological Studies*. What characteristics does this research report have to have in order to be recognized as a true piece of scientific research?

Background Reading List

Bartlett, Laile E. "What Do We Really Know About Psychic Phenomena?" *Reader's Digest*, August 1977, pp. 82-87. *A sociologist sums up evidence that supports the existence of ESP.*

Brown, Michael H. "New Evidence on Psychic Phenomena." *Reader's Digest*, May 1981, pp. 113-117. *New research on ESP is reported . . . and questions about its meaning continue to arise.*

Cohen, Daniel. "ESP: Science or Delusion?" *The Nation*, May 9, 1966, pp. 550-553. *A general review of the controversy over ESP.*

Cowen, Robert C. "Is Your Mind Closed to ESP?" *Technology Review*, March 1971, p. 6. *The science reporter for the* Christian Science Monitor *discusses problems that scientists have in dealing with ESP.*

Diaconis, Persi. "Statistical Problems in ESP Research." *Science*, July 14, 1978, pp. 131-136. *A discussion of one of the fundamental issues surrounding research in parapsychology.*

Frazier, Kendrick. "UFOs, Horoscopes, Bigfoot, Psychics, and other Nonsense." *Smithsonian*, March 1978, pp. 55-60. *Describes efforts of scientists to test claims for paranormal phenomena.*

"Interview: Carl Sagan." *Omni*, November 1979, pp. 81-82+. *An interview with the recipient of the first Ph.D. in parapsychology granted by Cambridge University, dealing with some of the reasons for scientists' reluctance to accept ESP as a science.*

Krippner, Stanley, and Richard Davidson. "Parapsychology in the U.S.S.R." *Saturday Review*, March 18, 1972, pp. 56-60. *"While American researchers are trying to prove that parapsychological phenomena*

exist, the Russians are busy seeking practical applications."

"A Pyrrhonian Sledge Hammer." *Science*, August 12, 1977, p. 646. *A brief note announcing the creation of a new journal designed to "combat the public's propensity for belief in the supernatural." Try to look through an issue of the journal, if possible.* See also the note in *Science*, September 30, 1977, p. 1344.

Rice, Berkeley. "Mind Bending at Berkeley." *Psychology Today*, October 1980, pp. 8–12. *The first Ph.D. in parapsychology and the problems it presents for some academicians.*

Taylor, John. "Geller's Powers are Genuine!" and James Randi, "Geller is a Fake!" *Science Digest*, April 1976, pp. 56–66. *A pair of articles on one of the most famous exponents of ESP in recent times.*

Case Study #3: Primitive cultures

One way to understand the way scientists work and think is to compare them with men and women from other cultures who are also trying to make sense out of the world around them. In making this comparison we can ask questions such as:

1. In what ways are these men and women like modern scientists? In what ways are they different?

2. Is their approach to the study of nature "scientific"? Why or why not?

3. Does the word *science* mean different things at different times to different cultures? Why or why not?

For this activity, we have selected a number of very different, very simple cultures. They are primitive societies in which people live very much as most humans must have lived thousands of years ago. Their beliefs, knowledge, attitudes, and ways of doing things will contrast sharply with the culture you are familiar with.

It will be best if you are able to see a film that depicts one of these primitive cultures. If that is impossible, choose one of the selections from the *Background Reading List* and find out as much as possible about the culture described.

The Buck Stops Here

Your purpose in this activity is to decide whether science existed in primitive cultures. Select specific examples from the film or from your reading to support the answer you decide on. Then, in a group discussion, find out whether other students have come to the same conclusions you have.

Additional Questions

1. Human beings at all times and in all cultures appear to be interested in nature. Does that make all human beings "scientists"? Why or why not? Many humans also seem interested in trying to influence nature. Is this a scientific behavior? Why or why not?

2. Is the culture you live in today a "scientific" culture? What evidence do you have to support your answer?

3. In what ways is the human society you studied "primitive"? Is it "more advanced" than your own in any way? Is a scientific society always more advanced than a nonscientific one? Explain your answer.

4. In what ways are a witch doctor, a priest, and a modern physician alike? In what ways are they different?

5. A medicine man tells a woman she is ill because a spirit has shot arrowheads into her body. A modern physician tells a woman she is ill because she has a viral infection. Which of these is a scientific explanation, or are they both scientific? Explain your answer.

Background Reading List

Current articles on primitive cultures may be difficult to find. From time to time, a new "lost tribe" is found, and magazines may carry articles describing the culture of these peoples. The four magazine articles cited below are examples of this. In many cases, you may find it helpful to refer to introductory anthropology texts or one of the books listed below. However, the best way of getting the contrast you need for this topic is to view a film of primitive peoples. The films (and one recording) listed below will do a superb job of showing you what life in a primitive culture is like.

Articles

Heine-Geldern, Robert. "Vanishing Cultures." *Scientific American*, May 1957, pp. 39–45.

"Lost Tribe of the Tasaday." *Time*, October 18, 1971, pp. 58–60.

"A 'New' Stone Age People." *Science World*, November 1971, pp. 16–17.

"*Science World* Takes You to the Stone Age." *Science World*, May 1971, pp. 16–18.

Books

Frazer, Sir James George. *The Golden Bough*. New York: The Macmillan Company, 1922 (reprinted many times since).

Levi-Strauss, Claude. *The Savage Mind*. Chicago: The University of Chicago Press, 1967.

Mead, Margaret. *Coming of Age in Samoa*. New York: New American Library, 1928 (reprinted many times since).

_____. *Growing Up in New Guinea*. New York: New American Library, 1930 (reprinted many times since).

Tylor, Sir Edward Burnett. *The Origins of Culture*. New York: Harper and Brothers, Publishers, 1958.

Films

Annual Festival of the Dead. Independent Film Producers.

Bushmen of the Kalahari. McGraw-Hill.

Calumet, Pipe of Peace. Extension Media Center, University of California (EMC).

Emu Ritual at Ruguri. EMC.

Himalayan Shaman of Northern Nepal. International Film Bureau.

Himalayan Shaman of Southern Nepal. International Film Bureau.

The Hunters. Contemporary Films.

Magic Rites: Divination by Animal Tracks. Independent Film Producers

Magic Rites: Divination by Chicken Sacrifice. Independent Film Producers.

Painting with Sand: A Navajo Ceremony. Encyclopedia Britannica Films.

Pomo Shaman. EMC.

Primitive People. United World.

Requiem for a Faith. Hartley Productions.

Sucking Doctor (longer version of *Pomo Shaman*).

Trobriand Islanders. University College, London.

Walbiri Ritual at Gunadjari. EMC.

Walbiri Ritual at Ngama. EMC.

Ways of Mankind (recording, available from National Association of Broadcasters).

Case Study #4: Science and religion

Some of the most dramatic battles in the history of civilization have been those between science and religion. The attempts by the early Christian church to destroy Greek learning; the prohibition of the early Catholic Church on anatomical studies; the arrest, censure, and silencing of Galileo by the Inquisition; the conflicts that arose in the late eighteenth century between physicians and churchmen over the practice of vaccination. These are only a few of the examples that might be cited.

In some ways, these controversies seem fruitless, naive, and absurd. It's obvious to almost anyone that the "truth systems" of religion and of science are simply different. In religion, truth is revealed from a supreme being to some intermediary. People believe that truth by faith. They don't ask the intermediary to submit his or her truth to a committee of peers for testing and confirmation. And, once revealed, religious truth is usually regarded as absolute and eternal.

In science, an idea is considered true only after it has survived a great many tests over a long period of time by many individuals. The criterion for truth in science is pragmatic: a statement about the world is true if it works. If a scientific "truth" no longer works well in describing the natural world, it is no longer "true." Truth in science is relative and changeable.

In spite of this seemingly obvious difference, science and religion *do* come into contact. Perhaps the most famous of these conflicts was the one that arose when Charles Darwin proposed his theory of evolution in 1859. The response of church leaders to Darwin's two books—*The Origin of Species* and *Descent of Man*—was anger and outrage. The notions of organic evolution were profoundly at variance with the church's teachings about the history of the world. It was clear that Darwin and the Bible could not both be correct. The ideas Darwin suggested struck at the most fundamental tenets of Christian teaching.

In the long run, science won this battle, as it is almost certain to do in controversies over the description of natural phenomena. By the beginning of the twentieth century, there was hardly a biologist in the world who had not recognized the theory of evolution as one of the most powerful biological concepts ever developed. Today there are few biologists who would not agree wtih that statement.

But the battle between science and religion over evolution has not ended. It has simply changed location. Instead of being fought in science laboratories, it is being waged in science classrooms.

The Scopes trial in 1925 raised the question as to whether the ideas of organic evolution could legally be taught in the state of Tennessee, where a law prohibited teachers from mentioning the subject. The defendant, John Scopes, was found guilty of teaching evolution and fined. But the evolutionists clearly won the battle for people's minds. By the end of the 1960s, scarcely anyone would believe that the theory of evolution was still an issue in American classrooms.

The close of the 1970s, however, showed how wrong that view was. Fundamentalist Christians began once more to take up the battle against the "godless" theory of evolution. Having failed to get evolution *out* of science classrooms, the new strategy was to get Christian teachings *into* them. Over the past decade, then, the efforts of these factions were to force science teachers to include the Biblical (creationist) account of the origins of the earth *alongside* those of Darwinian evolution.

The complete history of the events of the last decade would require more space than is available here. It will be essential for you to read one of the starred selections in the *Background Reading List* to understand the main features of the story. Be sure you find out, also, what the current state of affairs is with regard to this controversy.

The purpose of taking up this issue here is to decide whether modern creationists have a point: Does the Biblical account of creation qualify as a legitimate scientific theory? Does it deserve to be treated in science classrooms as would any other idea in science? Is evolutionary theory itself scientific? Or is it a religious dogma which does *not*, therefore, belong in a science classroom?

The Buck Stops Here

You are a member of the Wallace County school board. The board has received a petition from the Faithwell Baptist Church requesting that the Biblical (creationist) theory of the origin of the earth be given equal class time in the county schools. They further request that no texts or other educational materials be allowed in the schools unless equal attention is paid in them to creationist theories. Should the board decline this request, the church asks that evolutionary theory *not* be taught in the schools. Based on your readings and discussions with other class members, how would you vote on this petition?

Additional Questions

1. How do we know if a religious statement is "true"? How do we know if a scientific statement is "true"? Can a single statement be "true" in one context, but not in another? If so, does this mean some truths are more or less true than others? Explain your answer.

2. The text refers to some dramatic battles between religion and science. Choose any of the examples mentioned there (or find another example) and examine the case in more detail.

3. In what sense did Darwin's theory of evolution present a challenge to Christianity in the 1850s and 1860s? Does it pose the same challenge today? Why or why not?

4. "A person who is committed to a scientific way of understanding the world cannot also believe in religion." Develop an argument that would *support* that viewpoint. Then prepare another argument that would *oppose* the position.

5. Resolved: Individuals who argue that the creationist theory of human origins must be included in biology texts should also be willing to have the theory of evolution included in future editions of the Bible. Choose one side or the other of this debate to argue.

6. Many laypersons think that scientific truth is firm, constant, and immutable. Yet, the text above claims that "truth in science is relative and changeable." Which of these statements is more true? Explain.

7. Which of the following is (are) a legitimate subject for scientific study:

   a. the raising of Lazarus by Jesus
   b. the explosion of Mt. Krakatoa in 1883
   c. the origin of the universe
   d. the miraculous healing of a woman in Ottawa in 1981

   How, if at all, are the above examples different from each other?

8. The Old Testament contains a number of descriptions of natural phenomena. Joshua's stopping the motion of the sun and Moses' parting of the Red Sea are two examples. Are these two examples (and others like them) "scientific" descriptions? Why or why not?

Background Reading List

The effort by creationists in the late 1970s and early 1980s to get "equal time" for their ideas in the schools led to the publication of a large number of articles on the

creation-evolution debate. A sample of these is listed below.

Alexander, Richard D. "Evolution, Creation, and Biology Teaching." *American Biology Teacher*, February 1978, pp. 90-104, 107.

Azar, Larry. "Biologists, Help!" *BioScience*, November 1978, pp. 712-715. *A philosophy teacher raises questions about evolutionary theory.* Be sure to see the responses in *BioScience*, April 1979, pp. 208-209 and pp. 238-241 and November 1979, p. 647.

Baer, Richard A. "They *Are* Teaching Religion in the Public Schools." *Christianity Today*, February 17, 1984, pp. 12-15. *An unusual viewpoint on this question.*

Bird, Wendell R. "Creationism and Evolution: A Response to Gerald Skoog." *Educational Leadership*, November 1980, p. 157.

Brennan, Anne. "The Creationism Controversy: The Religious Issues." *Commonweal*, October 22, 1982, pp. 559-561. *Perhaps the solution to the evolution-creationist debate is to make comparative religion a required subject!*

Broad, William J. "Creationists Limit Scope of Evolution Case." *Science*, March 1981, pp. 1331-1332.

Callaghan, Catherine A. "Evolution and Creationist Arguments." *American Biology Teacher*, October 1980, pp. 422-427. *A review of creationist criticisms of evolutionary theory.*

Chambers, Bette. "Why A Statement Affirming Evolution?" *Humanist*, January/February 1977, pp. 23-24.

Cloud, Preston. "'Scientific Creationism'—A New Inquisition Brewing." *Humanist*, January/February 1977, pp. 6- 15.

"Creation vs. Evolution: The Debate Goes On." *American School Board Journal*, May 1980, pp. 33-34, 38.

"The Creationists." A *Science '81* Special Section. *Science '81*, December 1981, pp. 53-60. *A supplement consisting primarily of two articles on "Creationism as a Social Movement." (John Skow) and "Creationism as Science." (Allen Hammond and Lynn Margulis).*

Ehrlich, Anne and Paul. "Ecoscience: Evolution and Ecoscience." *Mother Earth News*, July/August 1984, pp. 142-143. *Why creationism is "just one more mistaken ideology."*

Flaherty, Francis J. "The Creationism Controversy: The Social Stakes." *Commonweal*, October 22, 1982, pp. 555-559. *Some aspects of the Arkansas decision which have not received much attention, but should.*

Gish, Duane T. "Evolution, Creation, and Common Sense." *Mother Earth News*, November/December 1984, p. 168. *A response to the Ehrlich's statement by the leading spokesman for the creationist viewpoint.*

Gorman, James. "Creationists vs. Evolution." *Discover*, May 1981, pp. 32-33. *A report on the controversy in California and Arkansas. See especially the essay by Stephen Jay Gould that follows.*

Henig, Robin Marantz. "Evolution Called a 'Religion,' Creationism Defended as a 'Science.'" *BioScience*, September 1979, pp. 513-516. *A news update on current happenings in the evolution-creation debate. This article forms the basis for an ongoing discussion in the "Letters" column of many later issues of* BioScience.

LeClerco, Frederic S. "The Constitution and Creationism." *American Biology Teacher*, March 1974, pp. 139-145.

Lewin, Roger. "Evidence for Scientific Creationism." *Science*, May 17, 1985, p. 837. *Creationism claims to be a true science. This article reports on a study designed to test that claim.*

Mariner, James L. "The Evolution-Creation Controversy in the United States." *Journal of Biological Education*, March 1977, pp. 6-11.

Mayer, William V. "The Incompatibility of Science and the Supernatural: A Response to Gerald Skoog." *Educational Leadership*, November 1980, pp. 158-159.

Moore, John A. "Creationism in California." *Daedalus*, Summer 1974, pp. 173-190.

Moore, John N. "Evolution, Creation, and the Scientific Method." *American Biology Teacher*, January 1973, pp. 23-26, 34.

Nelkin, Dorothy. "The Science Textbook Controversies." *Scientific American*, April 1976, pp. 33–39.

Parker, Barbara. "Creation vs. Evolution: Teaching the Origin of Man." *American School Board Journal*, March 1980, pp. 25–26, 31–34.

Pipho, Chris. "Scientific Creationism: A Case Study." *Education and Urban Society*, February 1981, pp. 219–233.

Skoog, Gerald. "The Coverage of Evolution in High School Biology Texts." *Education Digest*, January 1985, pp. 58–60. *What has been the practical effect of creationists' attack on evolution in biology textbooks?*

_____. "Does Creationism Belong in the Biology Curriculum?" *American Biology Teacher*, January 1978, pp. 23–26, 29.

_____. "Legal Issues Involved in Evolution vs. Creationism." *Educational Leadership*, November 1980, pp. 154–156.

_____. "Texts for Today." *Scientific American*, March 1984, p. 64. *An update on recent work of the creationists in eliminating references to evolution in textbooks.*

Walsh, John. "Anti-evolution Rules Are Unconstitutional." *Science*, March 30, 1984, pp. 1373–1374. *A report on the decision of the Texas State Attorney General on the evolution-creationist debate in that state.*

Weinberg, Stanley L. "A Reply to Walker, Mertens, and Dendrix on the Creation-Evolution Issue." *American Biology Teacher*, December 1977, pp. 548–549.

Welch, Claude A. "Evolution Theory and the Nature of Science." *Science Teacher*, January 1972, pp. 26–28.

Case Study #5:
Science and technology

It's time to become even more careful and more clear about the terminology we've been using. Throughout the text we've referred to "science" and "technology," often in the same breath. It should be apparent from everyday usage that these terms are closely related to each other. But do they mean exactly the same thing?

The answer is, definitely not. When scientists talk about "science," they are probably referring to something that is more properly known as *basic* or *pure* research. These two terms are often used interchangeably. They refer to the kind of research which is done primarily for the sake of finding out more about the natural world. The research is not designed to solve some specific practical problem. It is aimed simply at furthering our understanding of how the universe is made up and how it operates.

Technology, on the other hand, is the use of scientific research in order to solve a particular practical problem. How can we improve the quality of a color television picture? What chemical can we find to combat cancer in humans? What changes in circuitry will increase the speed with which a computer works? Questions like these fall within the realm of technology or *applied* research.

Having defined these two general types of scientific research, we should then say that relatively few projects fall totally within one area or another. There are likely to be few projects in pure research for which a scientist can see absolutely no possible applications. And there are seldom examples of applied research in which some new information about the nature of the universe is not obtained.

Nonetheless, the differences between the nature of these two kinds of research are very real and they have important implications both for science and for society in general. The area in which this may be most important is that of finances. Where do researchers go to obtain the funding they need for pure research or applied research?

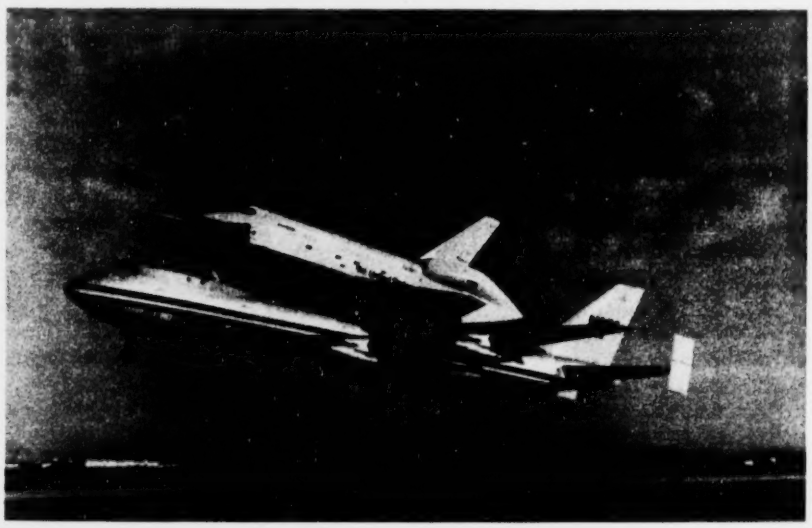
Not many years ago, that was a fairly simple problem. Scientific research up to World War II was relatively simple and inexpensive. Very significant discoveries could be made with equipment that a scientist could build himself or herself. A scientist could carry out important studies working alone or with a few collaborators.

But times have changed . . . and dramatically. Much of the research now being done requires enormously expensive equipment and staffs that number in the dozens or hundreds. Devices like particle accelerators and giant telescopes require years of planning and hundreds of millions of dollars for construction, maintenance, and operation. Where is money of that magnitude to come from?

One answer, of course, is industry. Giant multi-national conglomerates control enormous financial assets . . . ranging in the hundreds of millions or even billions of dollars. A company like Exxon, Mobil, U.S. Steel, or General Motors is financially capable of supporting significant levels of scientific research.

But what *kind* of research is this likely to be? Probably not pure research. Scientists, industries, and government all recognize the potential long-term applications of basic scientific research. But private companies are generally not willing to fund studies for which there is no fairly obvious application. In fact, with the exception of the Bell Telephone Research Laboratories, there are no major industrial centers that support basic research.

That leaves only one source of funding for most basic research . . . and certainly for the most expensive types of that research: the federal government. And, in fact, since scientific research became so expensive, it has been



Is the space shuttle an exercise in basic or applied research? Should this project be supported out of taxpayers' dollars? Why or why not? (photo courtesy of NASA)

the government to which basic researchers have had to appeal for the support of their projects. There seems to be little reason to believe that that pattern will change in the near future.

The support of basic research presents problems for the federal government also, however. How does a legislative committee justify spending tens or hundreds of millions of taxpayer dollars on research that is motivated primarily by an individual scientist's desire to know more about a particular topic? Should we take money from defense, human services, or education to support a study aimed at finding out whether protons spin clockwise or counter-clockwise . . . at determining the age of the universe . . . at finding out when in history the earth's magnetic polarity changed?

The legislative response to this dilemma has been to recognize the potential long-term benefits of basic research and reserve roughly 10 percent of government support for this aspect of scientific research. In the 1984 budget year, for example, Congress appropriated $12.1 billion for basic research, about 13 percent of the total funds allocated to research and development by the federal government. These figures change from year to year, depending on the social and political climate, but the amount set aside for basic research seldom exceeds the percentage for 1981.

Scientists recognize these facts of life. In designing their research projects, they usually try to search out potential long-term benefits that might be expected. These benefits are carefully pointed out in the proposals they make to the government for funding. But, in some cases, applications are difficult to find or too farfetched to mention. What can an astronomer hope to say about her research into the origins of the universe? Intellectually, few questions would seem to be of more fundamental interest in science. But how successfully can one justify this kind of research on utilitarian grounds?

It is just in some of these most basic areas of science then—the nature of the universe and the structure of the atom, for example—that the nation's policy-makers have the most difficulty in reaching fair and equitable decisions about the distribution of funding for scientific research. The *Case Study* that follows is a specific illustration of this dilemma.

The information you need for this case study is contained in the two documents that follow. The first of these is a letter from a group of universities to a congressional committee. It outlines a proposal for the construction of a new telescope which the universities hope the Congress will fund. The second document is a letter of transmittal from the chairman of the committee to the members of the committee.

Document 1:

To: The members of the Joint Committee on Atomic Energy, Subcommittee on Pure and Applied Research Grants
From: The members of the Inter-University Consortium of the Middle Southern States
Re: Research Proposal #AEC 19-538, A Proposal for a New Telescope in Kentucky

Gentlemen:
We are pleased to have the opportunity of appearing before you today in order to present our proposals for a new atomic-powered, ultra-high resolution, automatic direction finding, galactic-oriented telescope. The technical name for our instrument is the Astronomical Universe Finder, Ultra Laser Power (AUFUL). This AUFUL project represents a very important breakthrough in the science of observational astronomy. We expect that with this new instrument, we should be able to increase our observational potential from 3×10^9 light years to something close to 8×10^9 light years. As you know, this is better than any existing optical telescope and on a par with the projected Russian telescope planned for Outer Banzibashar in Siberia. The Soviet telescope is expected to attain an observational potential of about 7×10^9 light years.

The major advantage of the new telescope will be the impetus it should provide for theoretical as well as observational astronomy. The data collected by the proposed new telescope would probably allow astronomers to differentiate between the much-discussed "Big Bang" and "Steady State" theories of cosmology. At present, instruments are inadequate to collect the kind of data needed to choose between these two theories. Considerable value to the fields of ultramicroscopic spectroscopy and van Heuhrierre hydrogen fine-line differentiation is also to be expected.

The cost of the telescope is small compared to the values to be obtained. We estimate that construction will cost about $100 million (see budget for details), and annual upkeep will amount to about $3 million.

Because of the relative lack of scientific facilities in our part of the nation, we strongly recommend that the instrument be built on West Witch Hill, east of East Louisville, Kentucky.

Our representative, Dr. Bold from the University of Tennessee, will be glad to answer any questions you have on this proposal.

Document 2:

To: All members of the Joint Committee on Atomic Energy, Subcommittee on Pure and Applied Research Grants
From: Senator Arnold C. Twobley, Chairman
Subject: Enclosed proposal for funding

Representatives from the Inter-University Consortium of the Middle Southern States will appear before the Subcommittee next week to testify on their proposal for a new telescope in Kentucky. I have enclosed a copy of that proposal (Document 1) for your consideration. You will be able to ask any questions, raise any issues, and make any comments about the proposal you care to at that time.

To refresh your memory, I should point out that our current financial status is as follows:

1. Funds budgeted for all forms of scientific research and development this fiscal year $7,587,032,119.00
2. Funds requested for research projects in pure and basic research $6,987,909,354.54
3. Funds requested for research projects in applied research and development projects $14,872,243,100.75

I trust you will keep this information in mind as you attempt to reach a decision on the telescope proposal.

Distribution: Sen. Ardmore Finley (R-Alabama)
Sen. Bob Brown (D-California)
Sen. H. Throckmorton Grashis (D-Massachusetts)
Sen. "Tex" Okkie (R-Wyoming)
Rep. Melvin Motley (R-Arizona)
Rep. Irene Ulini (D-New York)
Rep. Connie Delaney (D-Michigan)
Rep. Terry Hudzpah (R-Tennessee)

The Buck Stops Here

Assume the role of any one of the legislators listed at the bottom of Document 2. Based on your readings plus the information contained in the documents pages 197 and 198, take a position that you think would be consistent with that of the person you are representing. At the conclusion of the committee hearing, you will be expected to vote for or against the proposal and to make a brief statement describing the basis for your vote.

Additional Questions

1. Write a one-page argument explaining why Proposal #AEC 19-538 *should* be supported by the federal government. Write a second one-page argument explaining why it should *not* be supported.

2. Suppose this proposal fails in the United States Congress. To what other sources or agencies should the consortium go for funding of the project?

3. In your opinion, why have the universities in the consortium not built the telescope with *their own* money? Should they? Explain.

4. To what extent and in what ways should *regional* factors (construction of the telescope in Kentucky rather than elsewhere) be a consideration in the subcommittee's decision?

5. Are there changes in the proposal which you think would make it more agreeable to the Congress? If so, describe them.

6. Suppose the prevailing view in the committee is that the telescope project should *not* be approved since there is no possible benefit to the citizens of the United States from the project. Can you imagine that the committee would ever approve *any* type of basic research? Explain.

7. How, if at all, is the mention of the Russian telescope relevant to this proposal?

8. List some questions that you, as a legislator, might want to ask Dr. Bold in the committee hearing in order to make up your mind on this proposal. Your questions may relate to scientific, technological, economic, political, or social aspects of this issue.

Background Reading List

Asimov, Isaac. "Pure and Impure." *Saturday Review*, June 9, 1979, pp. 22-28. *On the interplay of science and technology.*

Campbell, T.L. "Basic Science in Mission-Oriented Endeavor." *Science*, May 5, 1967, pp. 670-672. *Reports of a panel discusion on the needs for basic science.*

"A Debate Over No-Strings Funding of Research." *Chemical Week*, November 4, 1981, p. 28. *As governmental funds for basic research dry up, industry and higher education ask whether they can take up the slack in funding.* See also *Chemical and Engineering News*, November 16, 1981, pp. 45-50, for more details.

Henig, Robin Marantz. "Basic Research Has a Place, Says the Man with the Golden Fleece." *BioScience*, March 1980, pp. 149-152. *An interview with one of the Senate's most severe critics of basic research.*

Greenberg, Daniel S. "Fundamental Research vs. Basic Economics." *Discover*, January 1986, pp. 86-88. *A discussion of the ways in which economic realities determine the allocation of funds for basic research.*

_____. "'Hindsight': DOD Study Examines Return on Investment in Research." *Science*, November 18, 1966, pp. 872-873. Further articles on this study are found in *Science*, December 2, 1966, p. 1123; June 23, 1967, p. 1571; January 27, 1967, p. 397; September 29, 1967, p. 1512; and January 5, 1968, p. 34. *Reports of a Defense Department study on the utility of basic research.*

Hounshell, David A. "Edison and the Pure Science Ideal in 19th Century America." *Science*, February 8, 1980, pp. 612-617. *The work of Thomas Edison inspired a well-known scientist of the nineteenth century to issue a strong plea for pure science in America.*

Kingburg, John M. "One Man's Poison." *BioScience*, March 1980, pp. 171-176. *Three case studies that show the value of basic research in solving problems at a later time.*

Lederman, Leon M. "The Value of Fundamental Science." *Scientific American*, November 1984, pp. 40-47. *Why should society support basic research with tax dollars?*

Metz, William D. "Basic Research Funding: ERDA Deenergizes Nuclear Science." *Science*,

March 5, 1976, pp. 931-933. *What factors are involved in deciding whether or not to fund basic research?*

Thompson, Peter. "TRACES: Basic Research Links to Technology Appraised." *Science*, January 24, 1969, pp. 374-375. *Research attempts to find the link between basic research and technology.*

Townes, Charles H. "Quantum Electronics and Surprise in Development of Technology." *Science*, February 16, 1968, pp. 699-703. *A case history in the development of an important field of electronics and the applications that evolved from it.*

Walsh, John. "Historian of Science States Case for Catching Up on Basic Research." *Science*, March 17, 1978, pp. 1188-1190. *Some political considerations in the funding of basic research.*

Walton, Susan. "NSF Proposes Reorganization: Resists Technology Foundation Plan." *BioScience*, October 1980, pp. 709-710. *A sign of the times: Congress considers replacing part of the National Science Foundation with the National Technology Foundation.*

Weaver, Warren. "Basic Research and the Common Good." *Saturday Review*, August 9, 1969, pp. 17-18. *Some ethical issues raised by the conduct of basic research.*

Case Study #6: Space research

Undoubtedly the most expensive and most dramatic example of basic research in all history was the United States program to put humans on the moon before 1970. The effort, announced by President Kennedy in the 1960s, resulted from the confluence of many factors. To some extent, the whole NASA mission was probably a political move designed to rally support for the Kennedy administration. The desperate effort of American science and technology to regain world supremacy after the Soviet Sputniks of the late 1950s was also a factor. Of considerable importance, as well, were the pleas of scientists themselves to be allowed to expand their research to the next great frontier—space. The mystique of success that science had developed during and just after World War II probably gave somewhat more weight to scientists' words than they would have carried years earlier and, probably, during our own days. Whatever the case, the United States government responded to these pressures by pouring an unprecedented sum of money into space research during the decade of the 1960s. At its peak, NASA alone was budgeted at $5.858 billion for fiscal year 1966.

Perhaps the most amazing aspect of the whole NASA story was the fact that it was essentially an exercise in basic research. To be sure, the space program has spawned an enormous number of by-products that have already found their way into our daily lives. But it would be difficult in the extreme to argue that the space program was an example of applied research: no plans are now being made for regular trips to the moon; no mineral deposits have been opened there; nothing concrete, practical, or useful, in fact, has come from the Apollo space trips, other than further knowledge about the structure and history of the moon. Indeed, NASA publicity itself has referred to the space program as the next great step in human exploration of the universe. The program was "sold" not only as a great national effort to compete with the Soviet Union, but also as an opportunity for every American to help push back the frontiers of scientific knowledge. Whichever argument carried the greater weight, the fact is that the United States invested an almost unheard-of sum of money in a project that was, for the largest part, pure research without any promise of immediate practical benefit to the nation.

Space research is sometimes justified on the basis of many useful products that result as by-products of this research. In that case, should private corporations be encouraged to join together and carry out this research for the nation? Why or why not? Do you believe that the federal government should support research in space? Why or why not? (photo courtesy of NASA)

The days of the public's infatuation with science are, however, probably over. The space budget has continually been cut back since 1966. And some of NASA's priority projects (like a "Grand Tour" of the outer planets) have been cancelled because of insufficient funds. Many citizens and not a few legislators have come to the conclusion that environmental and ecological problems of the nation deserve priority over any more space voyages in the

near future. Any dollar spent on sending a human to Mars or beyond, they point out, is not available to be used in eliminating pollution from our air and water, in reducing hunger, or in solving a dozen other immediate and very real problems faced by humans here on earth.

But whatever the changes in politics and economics, space remains a *scientific* reality. The challenges that urged scientists toward the moon are still there. Much still remains to be learned about the moon itself. There is even more to be uncovered about the origin of the universe. And, of course, the other planets themselves await further exploration and study. Scientists can hardly be blamed, therefore, for lobbying for further extensions of NASA and other space programs.

What will be the next step in space science? Among the answers proposed is one by a husband and wife research team at the Orion Space Center, Dr. Nuclea Fissiks, and his wife, Asta. The Fissiks argue that the nation must begin making plans immediately for a manned space flight to Mars, in the late 1990s. Our flights to the moon must be thought of as only the first step in a complete exploration of the whole solar system. Earlier earthbound explorers did not stop when they had found one Caribbean island, or one shoreline in North America. They kept going until every inch of this planet was thoroughly explored. It is unthinkable, the Fissiks claim, that humans will ever stop short of a similarly complete exploration of other planets, especially now that flights to the moon have proved to be so successful.

In the long sweep of things, then, humans will continue to travel the unknown, simply because "it's there." The question is really not *whether* to go ahead with space travel, the Fissiks insist, but *when*. And, from an economic and scientific standpoint, the answer to that question is: the sooner, the better.

The project the Fissiks propose is a three-stage program consisting of (1) an unmanned landing of equipment on the surface of Mars in 1990, (2) a series of manned landings on the planet between 1993 and 1997, and (3) the establishment of a colony of some 200 residents there by the year 2000. Long-term costs for such a project can, of course only be estimated at this point. The Fissiks recommend, however, that NASA's budget be restored to at least its 1966 peak level of about $6 billion, and then doubled every three years until it reaches about $96 billion by the middle 1990s.

The Buck Stops Here

You are a member of the Congress of the United States who will be asked to vote on this issue. You should remember that many factors are likely to influence your decision and your vote. You have to think not only about the scientific and technological aspects of the proposal, but also about political pressures from your own state, lobbying by special interest groups, the relative demands of other groups (health, welfare, education, housing, etc.), the budgetary limitations provided by the administration, and so forth. Choose any one of the Congressional roles listed below and examine the Fissiks' proposal from that perspective. You and other class members will meet in legislative committee to discuss the proposal and come to some conclusion about it. At the end of your meeting you should be prepared to make a brief statement summarizing your position on the proposal and then to vote for or against it.

Sen. Ardmore Finley (R-Alabama)
Sen. Bob Brown (D-California)
Sen. H. Throckmorton Grashis (D-Massachusetts)
Sen. "Tex" Okkie (R-Wyoming)
Rep. Melvin Motley (R-Arizona)
Rep. Irene Ulini (D-New York)
Rep. Connie Delaney (D-Michigan)
Rep. Terry Hudzpah (R-Tennessee)

Additional Questions

1. List as specifically as you can all the benefits of space exploration that you can think of.
2. How would you evaluate the Fissiks' general argument about the long-term prospects for space research?
3. In general do you tend to favor or oppose further research in space? Explain your answer. What kind of space projects do you think should be undertaken?
4. "It is not possible to take a 'halfway' position on space research. Space sciences are so expensive that nothing worthwhile can be done for less than tens or hundreds of millions of dollars. Taken together, these statements imply that any space research will withhold very large sums of money from the solution of more immediate, more important social problems. Therefore, *no* space research of any kind should be conducted until present environmental and ecological issues have been solved." Comment on this line of reasoning.
5. The Fissiks draw an analogy between exploration of the solar system and exploration of the earth. Do you see any fallacies or weaknesses in that analogy?
6. What arguments can you offer for the support of basic research with government funds?

7. The ratio of federal support of scientific research for applied and basic research normally runs between ten-to-one and twenty-to-one. Do you believe that this is a reasonable ratio? Explain why or why not.

8. Assume (as is usually the case) that requests for support of basic research projects call for roughly ten times as much money as is available to spend. What criteria would you use for deciding which 10 percent of the requests will be funded? (Relevance, or practical application, can obviously not be used!)

9. Should the United States be concerned about being "first" or "best" in the world in scientific research? To what extent should that be a national goal? Since a concern like that was a powerful motivating force behind the moon program, perhaps similar appeals to national pride can be used to support other programs in basic research. What do you think of that method as an approach to the funding of basic research?

Background Reading List

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Benton, Marjorie Craig. "Outer Space Programs." *Department of State Bulletin*, January 1978, pp. 56-58. *A brief report to the United Nations General Assembly on achievements in and plans for space research.*

Frosch, Robert A. "NASA and Planetary Exploration: What Lies Ahead?" *USA Today*, January 1981, pp. 34-40. *NASA's administrator tries to outline his agency's future and explain both pure and applied benefits to be expected from space research.*

Grey, Jerry. "Implications of the Shuttle: Our Business in Space." *Technology Review*, October 1981, pp. 32-46. *An overview of the shuttle program and its implications for further space research.*

Kantrowitz, Arthur. "The Relevance of Space." *Bulletin of the Atomic Scientists*, April 1971, pp. 32-33, with response in December 1971, pp. 2-3. *An argument for the relevance of the space program.*

Lapp, Ralph E. "Investing in Space." *The New Republic*, January 11, 1969, pp. 12-13. *Some basic questions about the purpose of space research.*

Mark, Hans. "The Next Twenty Years in Space." *Vital Speeches*, May 1, 1978, pp. 442-445. *The undersecretary of the United States Air Force tells the National Space Club what he thinks is coming in space travel and space colonies.*

Morgenstern, Joseph. "What's It to Us?" *Newsweek*, July 7, 1969, pp. 64-68. *Some arguments for and against the space program by "the man in the street."*

Michener, James. "Space Exploration." *Vital Speeches*, July 15, 1979, pp. 578-581. *A famous (nonscientist) author discusses the military and non-military advantages of space research.*

Overbye, Dennis. "Time to Halt the Retreat from Space." *Discover*, March 1981, pp. 82-85. *"A renewed program would broaden the frontiers of technology, as well as of the mind and spirit."*

Schaurer, Eric. "A Slight Oversight: Congress' Space Probe." *Washington Monthly*, September 1979, pp. 23-27. *A look at the politics of the United States space program.*

Smith, R. Jeffrey. "Uncertainties Mark Space Programs of the 1980s." *Science*, December 14, 1979, pp. 1284-1286. *An analysis of the possible and probable future of the nation's space program.* See also the related article on pp. 1288-1289.

Waldrop, M. Mitchell. "Space Science in the Year of the Shuttle." *Science*, April 17, 1981, pp. 316-318. *What else is happening and is being planned in a period when the space shuttle is foremost in everyone's mind?*

A valuable resource on this topic is the magazine *Space World*.

Topic two Monitoring the fruits of scientific research: The social responsibility of scientists

Introduction

The case studies in this text cover a diversity of topics. But, taken together, they lead to one inescapable conclusion: science and technology are involved in a staggering variety of modern social problems. It is simplistic to say that scientific and technological progress *causes* new social, political, economic, ethical, and philosophical issues. But the fact is that most steps forward in science and technology today are accompanied by new questions, new choices, new opportunities in many other parts of our lives.

One question which has bothered laypersons and scientists alike—long before pollution, pesticides, genetic engineering, and energy became serious issues—is the extent to which an individual *scientist* is responsible for his or her inventions and discoveries. As far back as the 1890s, Alfred Nobel was racked with guilt about his discovery of dynamite. As penance to his own personal anguish over the question, he left the proceeds of his invention to be used to advance the welfare of humankind in the form of the Nobel Prizes.

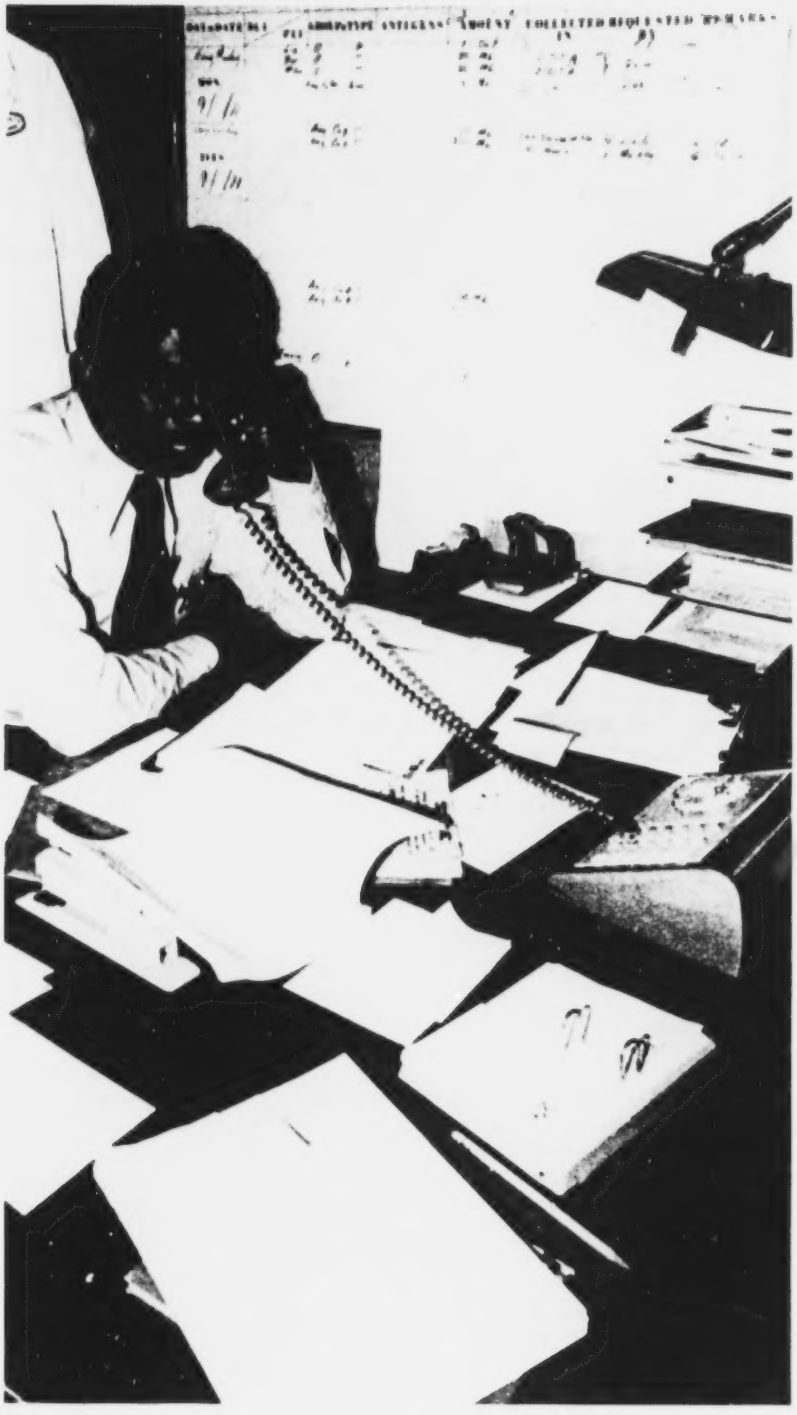
As scientific progress has accelerated, the questions of "responsibility" have been asked more and more often. Should we blame Albert Hoffman for his accidental discovery of the effects of LSD for the misuse of this drug in contemporary society? Should we guard against scientists at Dow, Upjohn, Mallinckrodt, and other chemical companies who produce chemicals like napalm that were used so inhumanely in the Asian wars? Are those doing research on the neutron bomb today "guilty" of any uses to which that bomb may someday be put?

Some would say that the scientist, indeed, *is* responsible for his or her discoveries. Scientists are experts who know best the ultimate consequences of their work. They should monitor the uses to which discoveries and inventions are put. Besides, if the discoveries and inventions were never made or announced in the first place, social problems could never arise. To others, this places an unfair and unrealistic burden on the scientist. The researcher's job, they say, is to uncover "truth." Scientists have neither the time nor the obligation to follow all possible applications through all parts of society through all time.

The resolution of this issue—if there is such a thing—probably lies somewhere between these extreme positions. Scientists can hardly give up their research and spend full time regulating the applications of their work. Neither can they be entirely excused from thinking about the issue. The following case study is a fictional one, but it contains many elements of a comparable real situation. The problem is a very complex one. Reading the additional questions first may help explicate some of the specific issues involved.

Case Study: A new form of transportation

Professor I.M. Stuphy is a member of the research staff of the chemistry department of Hopeless University. During the past seven years, Professor Stuphy has been working on the development of a new chemical compound, 4,4-diethyl — N,N — diazoaminohexamethylene dicarbamide (DIMACARB). Professor Stuphy became interested in this compound because of certain similarities between it and lysergic acid diethylamide (LSD). After years of research and study, Dr. Stuphy has synthesized the compound and has systematically and extensively studied its effects on experimental



animals and on humans. He has found that:

1. When taken in small doses (1–2 grams), DIMACARB produces instant interspatial transport. That is, it causes an organism's body molecules to disassociate and reassemble in some other place. Put even more simply, a person could take a DIMACARB pill, think of some other city or state in which he wanted to be, and be instantly transported there.
2. In some rare cases (about one time out of 80,000), the body molecules disassociate, but fail to reassemble. No trace of experimental animals experiencing this problem has ever been found.
3. Research on human subjects and on experimental animals has produced roughly comparable results.

As he would in the case of any new discovery or invention, Dr. Stuphy intends to submit a complete and thorough report of all his work to some reputable and recognized scientific journal in his field, perhaps the *Journal of Biological and Physiological Chemotherapeutics*. When this report, or series of reports, has been published in the journal, his professional responsibilities as a research scientist are essentially

You are a research scientist working for the National Institutes of Health. You have reason to believe that procedures followed in the research laboratory where you work are unsafe for workers in the lab. You have complained to your supervisor, but she disagrees with your complaint and insists that nothing need be done to pursue this matter further. What do you do? (photo courtesy of the National Institutes of Health)

complete. He may, of course, continue to work on this compound and its effects, but by publishing the report he establishes his right to credit for the discovery. At the same time, he places all the knowledge he has gained on this subject in the "public domain" and at the disposal of his colleagues in science.

The Buck Stops Here

As a member of the National Committee to Promote Social Responsibility in Science, you have been asked to make a judgment as to whether Dr. Stuphy has any further responsibilities in this matter (beyond the professional ones described above). Explain the position you take. If you say he should have further responsibilities, decide what the nature of these responsibilities are to be and how Dr. Stuphy is to discharge them. Someone—probably the instructor—should play the role of Dr. Stuphy. Stuphy should answer questions of fact about his research and respond to your suggestions, but should not offer his own ideas about the resolution of this matter.

Additional Questions

1. The case refers briefly to a scientist's professional responsibilities after making an invention or discovery. Find out *exactly* what would happen, under normal circumstances, after Stuphy had completed his or her research.

2. A fundamental tenet of science is that every researcher must provide other scientists with free access to the knowledge he or she has gained. It is only by this process that results can be checked and verified. If that's true, Stuphy has *no choice* but to release the information on DIMACARB. Does that mean that this whole case study is really a false issue?

3. There are some sound professional reasons that Stuphy would want to publish his results as soon as possible. What are they?

4. The loss of one experimental animal in 80,000 seems like a small ratio. Is this an acceptable risk for the drug?

5. What are some possible benefits and problems associated with the commercial use of DIMACARB?

6. Suppose that Stuphy decides, in the end, simply to go ahead and publish his results and to ignore *all* advice given by the national committee. Do you have any further suggestions?

Background Reading List

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Bridgman, P.W. "Scientists and Social Responsibility." *Scientific Monthly*, August 1947, pp. 145-154. *Some constraints on scientists when they act in social roles.*

Bugliarello, George. "A Technological Magistrature." *Bulletin of the Atomic Scientists*, January 1978, pp. 34-37. *"The time has come for the engineering profession to face up resolutely to the issue of its relationship to societal values."*

"The *Bulletin* and the Scientists' Movement." *Bulletin of the Atomic Scientists*, December 1985, pp. 19-30. *A fascinating review of the early history of this journal, a publication that has consistently dealt with moral and ethical issues of nuclear science for 30 years.*

Caspar, Barry M. "An Appeal to Physicists." *Bulletin of the Atomic Scientists*, October 1984. p. 9. *The author argues that physicists have a "special responsibility and a special opportunity to provide moral leadership in preventing nuclear war."*

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Edsall, John T. "Two Aspects of Scientific Responsibility." *Science*, April 3, 1981, pp. 11-14. *A good, general article on some concrete problems of scientific responsibility in the modern age.*

Glassman, James K. "Harvard Genetics Researcher Quits Science for Politics." *Science*, February 13, 1970, pp. 963-964, and discussion in March 27, 1970, pp. 1668-1669. *One scientist's interpretation of his "social responsibility."*

Goodman, Paul. "Can Technology be Humane?" *New York Review of Books*, November

20, 1969, pp. 27-34. *The impact of technology on society can best be assessed and regulated by technologists themselves. The crisis of confidence in technology is examined ir. an historical, social, and religious context.*

Green, Harold P. "The Recombinant DNA Controversy: A Model of Public Influence." *Bulletin of the Atomic Scientists*, November 1978, pp. 12-16. *The author compares the way scientists dealt with a difficult problem in 1945 (the atomic bomb) with the way they are dealing with another tough issue in the 1970s (recombinant DNA research).*

Holden, Constance. "Public Interest: New Group Seeks Redefinition of Scientist's Role." *Science*, July 9, 1971, pp. 131-132. *A description of the formation of the Center for Science in the Public Interest, established to get scientists more involved in the social implications of their work.* See also February 4, 1972, p. 501.

Nelson, Bryce. "M.I.T.'s March 4: Scientists Discuss Renouncing Military Research." *Science*, March 14, 1969, pp. 1175-1178. *The Vietnam conflict causes a group of academic scientists to think twice about the way the government is using their research.*

Orthwein, William C. "Engineer's Role." *Science*, November 12, 1971, pp. 645-646. *An argument that the engineer is not responsible for the use that society makes of his or her innovations.*

Pauling, Linus. "The Social Responsibility of Science and Scientists." *The Science Teacher*, May 1966, pp. 14-18. *A Nobel laureate in both science and peace presents his views on the subject.*

Quammen, David. "The Conscience of the Young Scientist." *Esquire*, December 1985, pp. 223-227. *Modern day researchers on nuclear weapons can learn something from the moral crises that confronted their predecessors at the Los Alamos laboratories in World War II.*

Rose, Hilary, and Steven Rose. "Knowledge and Power." *The New Scientist*, April 1969, pp. 108-109. *Two organizers describe the formation of the British Society for Social Responsibility in Science.*

Russell, Bertrand. "The Social Responsibilities of Scientists." *Science*, February 12, 1960, pp. 391-392. *One of the great philosophers of the twentieth century writes on the subject.*

Schawlow, Arthur L. "Is Your Research Moral?" *Physics Today*, December 1969, pp. 118-119. *The writer argues that the general public must be responsible for the uses made of scientific discoveries.*

Snow, C.P. "The Moral Un-Neutrality of Science." *Science*, January 27, 1961, pp. 255-262. *Scientists, by the very nature of their occupation, have certain important social responsibilities.*

Weaver, Warren. "Basic Research and the Common Good." *Saturday Review*, August 9, 1969, pp. 17-18. *The special ethical problems involved in basic (as opposed to applied) research.*

_____. "Some Moral and Technical Consequences of Automation." *Science*, May 6, 1960, pp. 1355-1358. *". . . though machines are theoretically subject to human criticism, such criticism may be ineffective until long after it is relevant."*

Wiener, Norbert. "A Scientist Rebels." *Atlantic Monthly*, January 1947, p. 46. *Disturbed by the uses to which government has put his inventions, this scientist refuses to release any more of his research in some areas. An extraordinary statement which you should surely try to read.*

Wilson, R.R. "The Conscience of a Physicist." *Bulletin of the Atomic Scientists*. June 1970, pp. 30-35. *A physicist describes his awakening to his social responsibilities as a result of his work on the atomic bomb.*

Topic three
On trying to make a difference: The scientist as politician

Introduction

For scientists, the question of social and ethical responsibility is not a new one. Almost from the moment that modern science appeared, practitioners have recognized the impact of their work on society and have asked how they can help their fellow citizens deal with the changes brought about by science. About the only thing that is new about this issue in the last half of the twentieth century is the magnitude of these questions. Scientific and technological progress occur so rapidly today that there seems to be no end to the social and ethical questions they create. In addition, the scope of these questions does not extend simply to the lives of a few individuals or the fate of a single state, as they once did, but to the future of humankind itself. Research in nuclear power, genetic engineering, and behavior modification now raise fundamental questions about what it means to be human and what future the human race can have.

Under these circumstances, more scientists are beginning to ask not *whether* they have social and ethical responsibilities, but *how* they are to act on those responsibilities. A number of possible alternatives have been suggested. A few scientists have actually given up their profession, left their research behind them, and become full-time social activists or educators. Others have taken less extreme actions, trying to affect social and political policy by circulating petitions, serving on committees, giving speeches, lobbying legislators, and taking part in other, more traditional forms of political activity. A few have run for political office and tried to influence public policy directly through a governor's office or a legislative seat.

It is important to recognize that the social and political activity of scientists consists of two quite different kinds of activity. The first includes providing advice through governmental agencies, institutions, and other formal channels on topics

on which the scientist is a specialist. The United States government and many state governments have long provided concrete, formalized mechanisms by which they ask for and receive expert advice on nuclear power, energy sources, military weaponry, and other topics in science and technology. The nature and function of these advisory systems is the subject of the next topic (page 212).

A second avenue through which scientists express their viewpoints is more ambiguous and less formalized. It includes all those ways in which scientists attempt to influence not just governmental bodies, but the general public as well, on issues they think are important. These issues may or may not include topics that are within a particular scientist's realm of expertise. Probably the prime example of this form of political activity was the series of protests by various scientists over United States involvement in Vietnam in the late 1960s and early 1970s. At the time, scientists from every discipline took strong positions in opposition to that conflict. At the present time, we see somewhat similar patterns developing over the issue of nuclear energy in peace (power plants) and war (nuclear armaments).

The problems involved in this form of educational activity, however, are many and complex. For example, how should a governmental agency assess the opinion of a group of scientists when they speak outside their special area of expertise? Are these views to be classified as "expert" testimony to the government, or are they just the expression of opinion from another group of concerned laypersons? And what weight should be given to statements made by scientists when they discuss social, political, economic, or ethical questions in discussing national policy? Does their training in science make them better able to analyze and judge complex issues, even when these issues are not in their own field? Is the opinion of someone with a "Dr." or a "Ph.D." better, more dependable, or more likely to be correct—on *any* issue—than is the opinion of someone without an advanced degree? The case study that follows will help you think more concretely about some of these issues.

A world famous physicist testifies before a Congressional committee on the use of a questionable food additive. As a member of that committee, how do you evaluate the testimony of this witness? Is he an "expert" in the field? Is his opinion more valuable than that of, say, an architect or short-order cook? (photo courtesy of the National Institute of Health)

Case Study: A birth control petition

Dr. R.G.N. Whipple is professor of physics at Totwell University. Dr. Whipple is intensely concerned about many current social issues, nuclear power, solar energy, psychosurgery, and birth control among them. He is presently engaged actively in a campaign to make birth control information more readily available to the general public. Part of this campaign includes the distribution of the petition reproduced below. He is trying to get every member of the department of physics and the department of chemistry to sign the petition and then to reproduce the petition as a full-page advertisement in the *New York Times*.

A Petition to Improve the Quality of Birth Control Efforts

The following petition, approved and supported by the undersigned members of the departments of chemistry and physics at Totwell University, deals with the recent proposals of the Hon. Edith Learned, representative to Congress from Oak Ridge, for the establishment of a publicly financed clinic for birth control information. Rep. Learned's bill would create a center through which any citizen could obtain 1) information on birth control, contraceptive techniques, and abortion services, and 2) free contraceptive aids and inexpensive abortion surgery.

The undersigned enthusiastically endorse Rep. Learned's bill for the following reasons:

1. Continued population growth is one of the major factors responsible for other science-related problems—such as air and water pollution, power shortages, and dwindling mineral supplies. As such, it must be solved before progress can be made in attacking other socio-scientific problems.
2. Scientific and technological progress has reached the point where dangers from the use of contraceptives and from abortion surgery are now very low, certainly within an acceptable range.
3. Every human being ought to have the right to decide the kind of medical care and treatment his or her own body should receive.
4. It appears questionable as to whether voluntary methods of birth control will be sufficient in stemming the tide of a growing population. We may eventually have to resort to mandatory

measures to limit population. Before that time is reached, however, we should give every voluntary method of birth control—including Rep. Learned's clinic—a chance.

For the above reasons, we, the undersigned, strongly urge the legislature to consider thoughtfully and to adopt Rep. Learned's bill to create and fund a public birth control information clinic.

The Buck Stops Here

Choose one of the roles listed below.

Professor of Atomic Physics
Professor of Organic Chemistry
Professor of Analytical Chemistry
Professor of Acoustics
Professor of Inorganic Chemistry
Professor of Medical Chemistry
Professor of Electrical Engineering
Professor of Solid State Physics
Professor of Biochemistry
Professor of Optics

You can assume that you are a competent professional scientist engaged both in scientific research and in the teaching of science to college students. On the basis of information and attitudes developed through background readings, decide whether you would be willing to sign the petition 1) as it stands, or 2) with certain changes (which you should then try to get made and approved by other department members). You may choose not to sign the petition in any form whatsoever. In that case, you should decide whether to make this strictly a personal decision or to try to influence the viewpoints and decisions of other department members.

One caution: It may not be especially helpful to get into a long discussion on the relative merits of contraception and abortion as birth control techniques. That is a topic you may have analyzed elsewhere in this text. Concentrate here on the educational and political implications of taking the stand represented by the petition.

Additional Questions

1. Would your response to *The Buck Stops Here* have been different had you played the role of a member of
   a. the department of sociology?
   b. the department of psychology?
   c. the department of anatomy and physiology?
   d. the law school?
   e. the school of theology?

   Explain your answer in each case.

2. Suppose a medical doctor signed the above petition. Would his or her opinion carry a) more, b) less, or c) the same weight as that of a signer whose occupation was
   a. civil engineering?
   b. nursing?
   c. carpentry?
   d. the ministry?
   e. homemaking?

   Explain your answers in each case.

3. What statements in the petition are facts? Are these facts all correct? Which statements are opinions?

4. Experts may differ on the proper solution to a particular problem. How does a layperson decide whom and what to believe in a case like this?

5. It's possible for a scientist to be as biased on social problems as it is for anyone else. Describe a situation in which you might expect a scientist to have strong prejudices on a social issue. What clues might you look for in detecting a scientist's biases?

Background Reading List*

"Activist Groups Seek Ways to Bring Science into Politics." *Physics Today*, April 1969, pp. 79–80. *Some of the ways in which physicists have tried to become more influential politically.* See also follow-up stories in June 1969, pp. 69–71 and in *Science News*, February 12, 1972, p. 103.

Boffey, Phillip M. "Goffman and Tamplin: Harassment Charges Against AEC, Livermore." *Science*, August 28, 1970, pp. 838–843. *What happens when employees of a government agency take strong exception to the policies of that agency?* See follow-up in May 5, 1972, pp. 492–498. *This article should be read in connection with the second article following ("Radiation standards . . .").*

_____. "Nader and the Scientists: A Call for Responsibility." *Science*, February 12, 1971, pp. 549–551. *Ralph Nader advocates that scientists, engineers, and other professionals "blow the whistle" on undesirable activities of the organizations for which they work.*

_____. "Radiation Standards: Are the Right People Making the Decisions?" *Science*, February 26, 1971, pp. 782–783. *An interesting review of the complex regulatory system in one science-related area.*

*Be sure to refer to the general readings on the relationship of science, technology, politics, and government on pages xxi–xxii.

_____. "Scientists and Bureaucrats: A Clash of Cultures on FDA Advisory Panel." *Science*, March 26, 1976, pp. 1244- 1246. *The differing perspectives brought to political and social questions by these two groups.*

_____. "Tenure Controversy: Rejected San Jose Engineer is Wed to Red." *Science*, October 23, 1970, pp. 420-422. *What influence should a wife's political connections have on her husband's professional career?*

"The Changing of the Guard." *Science News*, June 13, 1970, p. 572. *To what extent does/ should a scientist's political beliefs influence his or her availability and service as a science advisor to the government? Some interesting case studies.*

Dismukes, Key. "What Should Society Expect from Scientists?" *Bulletin of the Atomic Scientists*, November 1979, p. 19-21. *Some things that scientists, as individuals and in professional groups, can do to influence public policy.*

Edsall, John T. "Two Aspects of Scientific Responsibility." *Science*, April 3, 1981, pp. 11-14. *What are some ways scientists can carry out their responsibilities to let the general public know about the risks of scientific innovation?*

Feld, Bernard T. "Scientists' Role in Arms Control." *Bulletin of the Atomic Scientists*, January 1970, pp. 7-8. *As the primary source of knowledge used in almost every new military weapon or technique, scientists have the ability to slow down the arms race through their own personal efforts.*

Free, Helen M. "Communicating Chemistry to Government." *Chemical and Engineering News*, August 19, 1985, p. 53. *What are some of the reasons for and methods by which chemists can provide politicians with information and expert opinion?*

Gonzalez, Henry B. "Scientists and Congress." *Science*, April 13, 1984 pp. 127-129.*Some recommendations for the ways in which scientists can influence Congress.*

Greenberg, Daniel S. "Scientists as Politicians." *Current*, April 1971, pp. 19-24. *Some of the ways in which science and scientists are inherently and unavoidably involved in political questions in our modern society.*

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McCall, Julian. "The Politics of Technology." *Environment*, March 1972, p. 2. *Although research is not always useful in solving or even helping to describe social issues, this does not prevent scientists from lobbying on those issues.*

McCormick, Mike, and Van Valkenburg. "Publish Congressmen's Votes in CE&N?" *Chemical and Engineering News*, September 14, 1981, pp. 56-57. *Should a professional journal in chemistry publish the voting records of members of Congress on issues of concern to chemists? This article generated considerable debate in later "Letters" columns as, for example, in April 4, 1982, p. 4.*

Nader, Ralph. "The Scientist and His Indentured Professional Societies." *Bulletin of the Atomic Scientists*, February 1972, pp. 43-44. *The special responsibilities for social action that fall to scientists because of their special knowledge and occupational roles.*

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"Scientists and Citizens: When Are They Different?" *Science News*, January 8, 1972, pp. 21-22. *How can scientists use their expertise on important national issues?*

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Topic four
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saying that formaldehyde is a human carcinogen, a government scientist finds himself under notice to quit."

Task Force of the Presidential Advisory Group on Anticipated Advances in Science and Technology. "The Science Court Experiment: An Interim Report." *Science*, August 20, 1976, pp. 653–656. *An explanation of the way a "science court" could resolve technical questions in socioscientific issues,* with response in September 10, 1976, pp. 950–951.

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Wade, Nicholas. "Academy to Campaign Publicly for Oppressed Scientists." *Science*, May 13, 1977, pp. 741–743. *One form of political action taken by members of the National Academy of Scientists.*

_____. "Division of Biologics Standards: In the Matter of J. Anthony Morris." *Science*, February 25, 1972, pp. 861–866. *An intriguing story of politics and science within an important governmental agency and of what happens to "whistleblowers" in such a circumstance.* Read this in connection with a following article (also by NW), "Division of Biologic Standards: Scientific Management Questioned." *Science*, March 3, 1972, pp. 966–970, with response in June 16, 1972, p. 1183.

Wald, George. "Remarkable Crime Bill." *Science*, December 11, 1970, p. 1153, with response in February 19, 1971, pp. 629–631. *A continuing discussion as to what constitutes an appropriate "political" role for scientists.* See also the Williams reference following.

Williams, Robley C., et al. "Southeast Asian Policy." *Science*, May 22, 1970, p. 917, with response in September 4, 1970, p. 927. See Wald reference above.

Ziman, John. "Human Rights and the Polity of Science." *Bulletin of the Atomic Scientists*, October 1978, pp. 19–23. *What role ought scientists to have in political controversies affecting scientific research and other scientists?*

Walsh, John. "Entomological Society of America: A Vote Which Raises Advocacy Issue." *Science*, August 20, 1976, pp. 658–661. *Entomologists look for the most effective way of influencing governmental policy on pesticides.*

_____. "Science for the People: Comes the Evolution." *Science*, March 12, 1976, pp. 1033–1035. *The status of Scientists and Engineers for Social and Political Action, a group organized in 1969 to protest the misuse of science and technology.*

Introduction

What is the proper role for science and technology in the United States government? That question would have made little sense to the founders of this nation. In 1776—and for at least a century after that—there was essentially no scientific establishment in the United States. In fact, prior to 1900, the number of world-famous American scientists could be counted on one hand.

It wasn't that the American people were uninterested in the natural world. Far from it! The young nation was eager to find out what its natural resources were and to learn how best to use them. Expeditions for discovery often included geologists, botanists, zoologists, and other scientists. Transportation problems on the far-flung continent made navigation and engineering important scientific occupations. And mining and agriculture were basic to the survival and growth of the nation.

It's not surprising, then, that the only "scientific" agencies established by the government in its early years were those that dealt with practical issues. The Patent Office was the first of these (1790), and the only scientific agency suggested by the Constitution itself (Art. 1, Sec.8). In addition, a few quasi-scientific departments grew out of the military needs of the young nation. The Corps of Engineers and the Surgeon General of the Army were examples of these. As the Civil War came and went, the role of science became somewhat more important, and agencies like the Naval Observatory (1842), the Smithsonian Institution (1846), the Department of Agriculture (1862), and the Geological Survey (1879) were established.

As the twentieth century dawned, a true scientific research establishment began to develop in the United States. American

Joseph Henry was the first secretary of the Smithsonian Institution. How was the Smithsonian founded? What role has it played in the development of American science? (photo courtesy of the Library of Congress)

contributions in genetics, astronomy, and chemistry were recognized, for the first time, as equal to those anywhere in the world. Yet the birth of this new research community still did not mean that science had moved into the mainstream of American society. The vast majority of Americans could go through life knowing not the first thing about cells, atoms, or gravitational forces . . . and not being worse off in the least because of this "deficiency."

The nation's governmental structure and budget reflected this fact. As recently as 1936, the federal government's budget for basic research amounted to only $6 million, most of which was targeted for research in agriculture. Few politicians or government leaders felt that our economic progress, social welfare, or national defense was endangered by this modest support of science. A case that illustrates the government's casual attitude toward science occurred in 1942. As the nation began its massive buildup for World War II, the American Chemical Society offered its assistance to the War Department. The War Department expressed its appreciation, but declined, noting that "it already had a chemist"!

It was World War II, however, that turned out to be the real turning point in the relationship between science and government. Whatever else the war demonstrated, one point stood out clearly in the minds of winners and losers alike: The nation with the best scientific establishment was the nation to bet on in any armed conflict. That point was—at least until the election of 1980—a principle to which almost every public official and politician in the United States subscribed.

The impetus given scientific research by the war soon began to reshape every aspect of American culture. Improved drugs and medicines, more sophisticated communications systems, a revolution in the computer industry, dramatic new medical and surgical techniques, a revolution in agriculture . . . the list goes on and on. Today there are few social, economic, military, or political questions in which science does not play an integral part.

Along with the explosion in science and technology has come a plague of social, economic, political, and ethical problems. The cases in the first part of this book attest to that fact!

But how has government responded to the dramatically expanded role of science in American society? That question is the point from which the next three case studies spring. We will consider, in order, the following questions about the role of science in the modern American government:

1. What kind of input can and should scientists have in determining public policy?
2. What role should government agencies have in monitoring the applications of science and technology in our society?
3. How, and to what extent, should the federal government determine and control scientific research in the United States?

Informing the government on scientific issues

Decisions on science-related issues are made in every branch of the government. The congress is responsible for enacting legislation on pollution, energy, space research, military weapons, health . . . the whole range of issues discussed earlier in this text. The executive branch is responsible for setting policy and carrying out the will of Congress on these issues. And the judicial arm is responsible for intrepreting and enforcing the decisions of the other two branches.

But how wisely and how effectively are these decisions made? The vast majority of legislators, judges, bureaucrats, and other governmental workers are *not* professional scientists. Occasionally a chemist, physicist, engineer, or medical doctor is elected to Congress or appointed to a Cabinet post. But that's the rare exception rather than the rule. Lawyers constitute by far the largest group of government officials. How effectively can a group of non-scientists decide whether to build a neutron bomb, what standards for water purity to enact, or when human life begins?

Presidents, Cabinet secretaries, legislators, and other officials have long recognized the need for good scientific advice. The National Academy of Sciences (NAS) was chartered more than a hundred years ago to provide just this kind of advice to the president and Congress. In recent years, a number of proposals have been made to improve the quality of scientific information available to public officials. Some of these are described in the *Background Reading List*. One of the most important has been the Office of Technology Assessment (OTA) created in 1972, as an attempt to provide Congress with information about the potential risks and benefits of new technological developments. Brief descriptions of both agencies are given below.

Serious questions remain, however, about the effectiveness of these advisory bodies. For one thing, scientists may disagree among themselves about "risk," "benefit," and other value judgments on the applications of science.

National Academy of Sciences

The National Academy of Sciences was established by an act of Congress approved by President Abraham Lincoln on March 3, 1863 (12 Stat. 806).

In 1916 President Woodrow Wilson asked the Academy to organize, under the terms of its charter, the National Research Council as a measure of national preparedness. The Research Council was perpetuated by the Academy on April 29, 1919, in response to a further request from President Wilson, and operates in accordance with Executive Order 2859 of May 11, 1918, as amended by Executive Order 10668 of May 10, 1956.

The National Academy of Engineering was established on December 5, 1964, when the Council of the National Academy of Sciences, under the authority of its Act of Incorporation, adopted Articles of Organization bringing the new Academy into being as a parallel organization. It is autonomous in its organization and election of members and closely coordinated with the Academy of Sciences in its advisory activities.

The Institute of Medicine was chartered by the National Academy of Sciences in 1970.

Purpose

The National Academy of Sciences (NAS) is an organization of distinguished scientists and engineers dedicated to the furtherance of science and its use for the general welfare. Although not a governmental agency, the Academy has long enjoyed close relations with the Federal Government. Its congressional charter of 1863 specifies that " . . . the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any service to the Government of the United States." Thus, no Federal funds are appropriated directly to the Academy, the principal funding mechanism typically being the negotiation of contracts with Government agencies.

The National Academy of Engineering (NAE) shares in the objectives and responsibilities of the NAS by bringing to bear the leadership of the Nation's most eminent engineers in sponsoring engineering programs aimed at meeting national needs, encouraging engineering research, and advising the Federal Government upon request in matters of engineering.

The National Research council (NRC), which was organized by the NAS to facilitate the participation of a broader representation of scientists and technologists in carrying out its objectives, serves as the principal operating agency of the NAS and NAE. As outlined in Executive Order 10668, the purpose of the Council is to stimulate scientific research and to foster the application of research findings to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, and of contributing in other ways to the public welfare.

The Institute of Medicine was established in recognition of the important and complex problems posed in the provision of adequate health services to all sectors of society. The Institute identifies, for study and analysis, important issues and problems that relate to health and medicine; initiates and conducts studies of national policy and planning for health care and health-related education and research; responds to requests from the Federal Government and other agencies for studies and advice on matters relating to health and medicine; establishes liaison with the major scientific and professional societies in the field; and disseminates information to the public and the relevant professions.

Activities

The Research Council does not maintain laboratories of its own but seeks to stimulate and support the work of individual scientists and engineers and to coordinate investigations dealing with broad problems in research both nationally and internationally. These purposes are carried out through a wide variety of means, including conferences, technical committees, surveys, collection and collation of scientific and technical data, the sponsorship of scientific and technical publications and research organizations, and the administration of public and private funds for research projects and fellowships. The Research Council provides unique means for organizing attacks on scientific and engineering problems which involve many specialized fields and for obtaining disinterested and objective assessments of scientific and technical problems. The effectiveness of the Research Council is dependent

on the voluntary, personal participation of thousands of American scientists and engineers who collaborate in these undertakings, giving generously of their time and effort without financial compensation.

The organization directly administers about $50 million annually of funds provided by contributions, grants, and contracts from Federal and State agencies, private industries and foundations, scientific societies, and individuals for support of its committees and conferences, research projects, and fellowships—a portion of which is used to supplement endowment income and gifts in meeting general expenses.

Office of Technology Assessment

The Technology Assessment Act specifies that OTA shall consist of a Technology Assessment Board, a Director and Deputy Director, a Technology Assessment Advisory Council, and such other employees and consultants as may be necessary in the conduct of OTA's work. The Congressional Board sets the policies of the Office. The Director, who is appointed by the Board for a 6-year term, is the chief executive officer and is responsible solely to the Board, of which he is a member. The function of the Advisory Council is to advise on such technology assessment matters as may be requested by the Technology Assessment Board.

The bipartisan 13-member Board includes six Senators appointed by the President pro tempore, six Members of the House of Representatives appointed by the Speaker, and the Director of OTA, who is a nonvoting member. The Board selects a Chairman and a Vice Chairman from among its members at the beginning of each Congress. The Chairmanship and Vice Chairmanship alternate between the Senate and the House of Representatives with each Congress.

The basic function of OTA is to provide congressional committees with assessments or studies that identify the broad range of consequences, social as well as physical, which can be expected to accompany various policy choices affecting the uses of technologies. More specifically, the functions of OTA are to: identify existing or probable impacts of technology or technological programs, and, where possible, ascertain cause-and-effect relationships; identify alternative technological methods of implementing specific programs; identify alternative programs for achieving requisite goals; make estimates and comparisons of the impacts of alternative methods and programs; present findings of completed analyses to the appropriate legislative authorities; identify areas where additional research or data collection is required to provide support for assessments; and undertake such additional associated activities as may be directed.

Requests for OTA assessments may be initiated by (1) the chairman of any standing, special, select, or joint committee of the Congress, acting for himself or at the request of the ranking minority member or a majority of the committee members; (2) the Technology Assessment Board; or (3) the OTA Director, in consultation with the Board.

In carrying out the provisions of the Technology Assessment Act, the Office cannot operate laboratories, pilot plants, or test facilities. It is authorized to secure directly from any executive department or agency information, suggestions, estimates, statistics, and technical assistance for the purpose of

carrying out its functions. According to statute, if certain expertise is required, OTA may request, and the head of any executive department or agency may detail, with or without reimbursement, any of its personnel to assist the Office.

The Librarian of Congress is authorized to make available to OTA such services and assistance of the Congressional Research Service as may be appropriate and feasible, and which are similar to the services provided to the Congress. Much in the same manner, the General Accounting Office may be utilized by the Office, and it is authorized to provide to OTA the same kind of assistance that it gives to the Congress.

The Office maintains a continuing liaison with the National Science Foundation (NSF) with respect to NSF grants and contracts for technology assessments, and for the purpose of coordinating technology assessment activities.

The Congressional Budget Act (88 Stat. 297) requires OTA to assist the Congressional Budget Office on matters concerning Federal science and technology problems.

Legislators have the same problem in deciding whom to believe as you may have had in earlier case studies. But far more important is the political context in which advice is sought and received. The agencies that exist operate primarily on a "request" basis. NAS, OTA, and other agencies study and report on issues the executive branch or Congress *asks* them to. Questions that scientists themselves see as crucial cannot be undertaken without the direction of some governmental agency.

Also, there is no certainty how much effect the scientific advice transmitted to Congress or the executive will have. You've already seen how complex issues of weaponry, weather modification, ecology, energy pollution, and the like can be. Scientific considerations can easily be relegated to second (or third or fourth) place behind economic, social, political, or religious considerations. For better or worse, a major criterion in formulating and enacting national policy is the necessity of politicians to get reelected. In this context, it may be tempting or convenient simply to ignore the advice of scientists.

The problem with this approach may be the increasing significance of science and technology in our society. The potential of discoveries and inventions like the neutron bomb, genetic engineering, and psychosurgery is enormous . . . far greater, perhaps, than scientific developments at any other phase of human history. These changes are simply too great, some critics would say, to be left to the whims of "politics as usual."

Case Study:
A constitutional amendment

Disturbed by the inefficent way in which government handles science-related issues, a group of scientists have proposed the following constitutional amendment. Their fundamental argument is that the Constitution was written at a time when science and technology were essentially irrelevant to everyday life in American society. The situation could hardly be less different today. Nearly every social issue involves scientific information in some way or another. In order to recognize that fact, the amendment proposes the establishment of a Society for the Appraisal of Policy in Science (SAPS). Here are the details of the proposed Amendment:

1. The primary advisory group for Congress in matters related to science shall be the Society for the Appraisal of Policy in Science (SAPS). The society is to consist of 100 scientists, 50 of whom are to be elected, one from each state, by the senators and representatives from that state. These fifty members will, in turn, choose an additional fifty scientists in such a way that all scientific disciplines are fairly represented in the society.

2. Each issue scheduled to appear before Congress and having a scientific or technological aspect is to be referred first of

all to SAPS. The society is responsible for conducting such investigation as may be necessary (research, interviews, testimony, etc.) in order to reach an opinion on the scientific merits of the issue. A final comprehensive report from SAPS reviewing all pertinent scientific data and recommending some specific course of action is to be presented to the Congress on each issue it receives.

3. The society has sole authority to take testimony from expert witnesses on scientific aspects of issues. The Congress will continue, as it has in the past, to take testimony and collect evidence on political, social, or any other nonscientific aspect of the issue.

4. If for any reason, two-thirds of the membership of SAPS finds a proposal pending before Congress to be scientifically unsound or unacceptable, the society may prohibit further consideration of that proposal. There is no recourse from this veto power by the society.

5. The society may initiate any proposal dealing with scientific and technological matters which it deems important to national policy. Congress is then obliged to consider such a proposal and explain in writing to the society why the proposal was or was not adopted.

6. Because of the delicate nature of many scientific issues with which the Congress deals, all communications between the society and the Congress will be TOP SECRET and unavailable to the public without special action of the Congress and the society.

The Buck Stops Here

Select any one of the following roles from which to assess the proposed constitutional amendment. Decide if there are any additions to, deletions from, or changes in the text printed above. Support your decisions with any factual information or expert opinion you can muster. Make your stand consistent with the position you believe would be held by the person you represent.

Dr. I. Tribbley Gardner, dean of academic studies, Massachusetts Institute of Technology (chairman)

Mrs. Lleda Huxley, president, League of Women Voters

Dr. Austin C. Austin, president, American Chemical Society

Dr. Patricia Mott, president, American Institute of Biological Sciences

Dr. Arby Dooley, chairman, department of astronomy, California Institute of Technology

Hon. Esta Wooster, representative (D) from Ohio

Hon. Amos Maskcz, representative (R) from West Virginia

Hon. Bill Brown, senator (D) from California

Hon. Emerson Huntley Dickerson, III, senator (R) from Massachusetts

Sanford Pulp, chairman of the board, American Paper Company

Earle Oole, chairman of the board, Universal Oil Company

Additional Questions

1. Where and in what context does the Constitution mention science and technology?

2. The argument in this case is that science and technology have a role in modern American society that is dramatically different from that of the mid-eighteenth century. This calls for fundamental changes in the Constitution itself. Is there any other aspect of society for which this can also be said?

3. From your readings or personal knowledge, list three specific issues presently before Congress on which SAPS might be expected to act.

4. Do the executive and judicial branches deal with the same kind of science-related issues as the legislative branch? Try listing three specific issues presently before these two branches of government, as you did for the legislative in Question 3.

5. Why were the executive and judicial branches not included in the proposed amendment? Ought they to have been? Why or why not?

6. What advantages would SAPS have over existing agencies (like NAS and OTA) that provide scientific advice to the government? What disadvantages?

7. How might the Congress operate differently if this amendment were passed? Would these differences be good or bad? Explain your answer.

Background Reading List

Anderson, Clinton P. "Scientific Advice for Congress." *Science*, April 3, 1964, pp. 29-32. *A somewhat dated article in which a United States senator discusses the question of how Congress is to be provided*

with the kind of information on science and technology it needs.

Ashford, Nicholas A., C. William Ryan, and Charles C. Caldart. "Law and Science Policy in Federal Regulation of Formaldehyde." *Science*, November 25, 1983, pp. 894–900, with responses in May 11, 1984, pp. 550–556. *A fascinating case study of the way in which government deals with difficult and ambiguous scientific issues.*

Bundy, McGeorge. "The Scientist and National Policy." *Science*, March 1, 1963, pp. 805–809. *One of the architects of American policy on Southeast Asia in the 1960s offers some guidelines for the participation of scientists in government activities.*

Carter, Luther J. "National Academy of Sciences: Unrest Among the Ecologists." *Science*, January 19, 1968, pp. 287–288. *A group of scientists is concerned that the government is not getting sound, objective advice on some important national issues.*

Cellarius, Richard A., and John Platt. "Councils of Urgent Studies." *Science*, August 25, 1972, pp. 670–676. *An interesting recommendation by two respected scientists that bears some resemblance to the case study for this topic.*

"DOE Uses Science Court Concept; Minnesota Does Not." *Physics Today*, November 1978, pp. 93–94+. *The science court idea involving debates between scientists on different sides of an issue is tried out by the federal government in a question about locating power lines.*

Eskridge, Nancy K. "Conflicting Academy Reports Leave EPA Bewildered." *BioScience*, May 1978, pp. 309–311. *How does a government agency decide on an issue when panels of experts give it different information?*

Etzioni, Amitai. "How May Congress Learn?" *Science*, January 12, 1968, pp. 170–172. *A comprehensive review of the problems of providing legislators with scientific information.*

Golden, William T. "Wanted: Proper Science Advice to Guide the Next President." *Science Digest*, October 1980, pp. 30–32. *The author designed the first system for providing scientific advice to presidents in the 1940s and assesses the current needs for this type of advice.*

Greenberg, David S. "Science and Politics." *Discover. This monthly column, begun in September 1985, is an extremely valuable update on issues in this area by one of the world's authorities on science and politics.*

Hapgood, Fred. "Risk-Benefit Analysis." *The Atlantic*, January 1979, pp. 33–38. *An explanation of the term and discussion of its application and uses.*

Henahan, John F. "Whatever Happened to the Cranberry Crisis?" *The Atlantic*, March 1977, pp. 29–36. *An updating on some important environmental crises of the recent past. Excellent for perspective on the nature of these "crises."*

"How Decisions are Made." *The Nation*, March 1969, pp. 355–356. *If the observations expressed in this article are correct, how are scientists to effectively influence important policy decisions involving science?*

Kerry, John F. "U.S. Science and Technology." Letter in *Science*, February 18, 1986, p. 907. *A letter by a U.S. Senator from Massachusetts in response to editorial in the January 31 issue of this journal.*

Krimsky, Sheldon. "A Citizen Court in the Recombinant DNA Debate." *Bulletin of the Atomic Scientists*, October 1978, pp. 37–43. *A case study of the way citizens responded to the establishment of a recombinant DNA laboratory in the community.*

Lepkowski, Wil. "Reshaping Ahead for U.S. Science Policy." *Chemical and Engineering News*, February 23, 1981, pp. 22–31. *The Reagan administration brought a new outlook to many phases of the federal government, including its relationship to science and technology.*

Lockeretz, William. "Arrogance Over Clean Air." *Science*, May 8, 1970, pp. 651–653. *Some problems in getting policymakers to listen to "good" advice.*

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Marshall, Eliot. "Scientists Quit Antibiotics Panel at CAST." *Science*, February 23, 1979, pp. 732-733. *How scientific information got mixed up with economic and political issues.*

Mesthene, Emmanuel G. "Can Only Scientists Make Governmental Science Policy?" *Science*, July 17, 1964, pp. 237-240. *Scientists are not necessarily the people best fitted to deal with the problems of governmental science policy.*

Monmaney, Terence. "Vitamins: Much Ado About Milligrams." *Science 86*, January-February, 1986, pp. 10-11. *An interesting insight into the differences of opinion that can result when scientists attempt to help government set policy.*

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"Need for U.S. Science Court." *USA Today*, October 1978, pp. 11-12. *A brief explanation of the "science court" idea with some suggestions for the way it could be used today.*

Nelson, Bryce. "ABM: Senators Request Outside Scientific Advice in Closed Session." *Science*, December 20, 1968, pp. 1374-1375. *How did a major senate committee get the scientific advice it needed on a crucial element in the nation's defense system? You might be surprised to find out!*

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Perl, Martin L. "The Scientific Advisory System: Some Observations." *Science*, September 24, 1971, pp. 1211-1215, with responses in April 21, 1972, pp. 229-230. *The writer describes the present system and attempts to assess its effectiveness.*

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Press, Frank. "Science and Technology in the White House." *Science*, January 9, 1981, pp. 139-145 and January 16, 1981, pp. 249-256. *An excellent, two-part series by a former presidential advisor for science and technology about the way his office operated.*

Sayre, Wallace S. "Scientists and American Science Policy." *Science*, March 24, 1961, pp. 859-864. *American "science policy" requires that some spokespersons for science be identified and that they have a mechanism for expressing their views.*

Shapley, Deborah. "Jason Division: Defense Consultants Who Are Also Professors Attacked." *Science*, February 2, 1973, pp. 459-462+. *Difficult questions about the proper role of scientists in working as advisors to the military establishment.* See also May 4, 1973, pp. 446-447.

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pp. 992–994. *This article describes efforts to use scientists' expertise to predict the effects of scientific and technological innovations on the social, political, and economic health of the nation. The plan was eventually implemented, and the Office of Technology Assessment was established in 1972.* See also Luther J. Carter. "Technology Assessment: NAE Report Explores the Methodology." *Science*, November 14, 1969, pp. 848–852, and Deborah Shapley. "Office of Technology Assessment: Congress Smiles; Scientists Wince." *Science*, March 3, 1972, pp. 970–973.

_____. "Disagreeing to Agree." *Science*, February 27, 1981, p. 908. *A brief review of a presidential commission's study of the relationship of science, technology, and society in the 1980s. You may want to see the full report.*

Wright, Susan. "Setting Science Policy: The Case of Recombinant DNA." *Environment*, May 1978, pp. 6–15+. *Developments in recombinant DNA research raise questions about how and by whom potentially hazardous discoveries and inventions ought to be monitored.*

Scientific agencies in the government

You might conclude from the preceding case that science and technology are not well-represented in the government. In fact, quite the opposite is true. Organizational charts in the Government Organizational Manual are liberally studded with agencies performing scientific functions in the government: The National Weather Service, The United States Fish and Wildlife Service, The National Bureau of Standards, The Bureau of Mines, The Office of Product Standards, The Office of Water Research and Technology, The Center of Disease Control are only a few of dozens of possible examples.

In some cases, agencies have evolved into somewhat unusual governmental bodies. They may exercise all three kinds of governmental functions: executive, legislative, and judicial. Working within general guidelines established by the president or the Congress, they may determine policy in their assigned field of specialization, create rules and regulations, and monitor industries, businesses, and individuals to be sure they conform to these rules and regulations.

This pattern is especially common among the "regulatory agencies" like the Food and Drug Administration (FDA), the Environmental Protection Agency (EPA), and the Occupational Safety and Health Administration (OSHA). As these names suggest, regulatory agencies are created to protect workers, consumers, private citizens, and the general public from risks resulting from new products, hazardous working conditions, environmental pollution, and other scientific and technological developments.

As science and technology have become more important in our society, so have the number and variety of regulatory agencies. And the "regulatory explosion" has, in turn, been accompanied by an increasing level of criticism about the way these agencies function. One objection is that many agencies are simply not very effective. They don't offer the protection they were designed to provide. Many reasons are offered for this: Staffs are not large enough, adequate money is not available, too much red tape is required, and so on.

One of the major complaints, however, is that agencies are too biased *toward* the special groups they are supposed to regulate. The constant shuffling of personnel back and forth between regulatory agencies and regulated groups is now well known. The person who passes on the safety of a new drug today may have been president of a drug company yesterday . . . or may hold that job next week.

Questions are often raised also about the way scientific advice is handled in government agencies. Political, economic, or military considerations may turn out to be more influential than scientific data. What appears to be the best scientific position on an issue may not be the one that actually wins out.

Recently a more fundamental question is being asked. What should be the function of a regulatory agency? Should it be simply to warn the general public of possible risks? Or should it be to ban products and services that are potentially harmful? For example, suppose that a food additive is known to cause a 5 percent increase in retinal cancer among laboratory animals. Ought the FDA, then, to prohibit the use of this chemical in foods? Or should it simply notify the public of this risk and let individuals decide whether or not to purchase foods that contain this additive? The following case study will allow you to think in more detail about the role of regulatory agencies in the government.

Some people feel that the government intrudes too much on the private lives of individuals. The Food and Drug Administration is often accused of "overregulation." Do you think the federal government (in the form of this FDA food inspector) should have the responsibility for monitoring the meals served in this factory? Can you establish any general guidelines about the ways and/or extent to which the government should oversee the eating habits of American people? (photo courtesy of The FDA Consumer)

Case Study and The Buck Stops Here

Assume that you have been hired as a speech writer for Alberta Q. Tocksict, candidate for the United States Senate. Your assignment is to prepare a position paper on the subject of "Regulatory Agencies in the

Federal Government." (Limit yourself to agencies concerned with some aspect of science or technology.) Read a selection of articles from the *Background Reading List* and some current articles on this topic. Then, prepare a list of complaints and criticisms found in these articles. Finally, prepare an outline that describes the changes you think should be made (if any) in the way regulatory agencies operate. If you think few or no changes should be made, explain why you feel this way. Your research should result in a campaign speech which Ms. Tocksict will present to her constituents. The class may choose to hear and react to two or more of these speeches.

Additional Questions

1. Select any one federal agency that deals with science-related issues and prepare a detailed report on its functions.

2. Regulatory agencies are likely to be staffed by (although not headed by) career men and women who stay with the agency year after year. It doesn't make much difference as to the administration in power. They continue to do their jobs, in contrast with presidents, Cabinet officers, representatives, and senators, who change every two, four, or six years. Is their continuity of service an advantage or disadvantage (or both)? Explain your answer in detail.

3. What advantages are there (if any) to the close ties that exist between regulatory agencies and the groups they regulate?

4. Does the federal government regulate business, industry, and private citizens too much? Try to find three specific examples that would tend to make you say "yes" to this question. Three that would tend to make you say "no."

   a. "The federal government should take absolutely *no action* to regulate the purchase and use of products (pesticides, drugs, and foods, for example) by private citizens."

   b. "The federal government should regulate strictly the purchase and use of *all* products (pesticides, drugs, and foods, for example) by private citizens."

   Few people are likely to agree with either of these extreme positions. What position somewhere *between* them would you agree with?

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Governmental control of science

What is the purpose of scientific research? That question has been the cause of much soul-searching, discussion, and debate both within and without science for over 300 years. There are some who would say that the main objective of scientific research is the increase of knowledge, an improved understanding of the natural world. The search for "truth," they proclaim, is its own justification. For others, however, the greatest value of scientific research lies in the contributions which it can make to the improvement of human life. The primary aim of science, these observers claim, should be to provide new inventions, compounds, and discoveries which will make our lives safer, healthier, longer, less burdensome, and more enjoyable.

Not too many years ago, this argument was essentially academic. Most scientists paid for their own research, so they were free to follow either of these objectives, "pure" or applied research. Today, however, that has largely changed. Scientific research in many areas requires vast sums of money, money which can usually be obtained only from the public coffers. The question is now being raised as to whether a scientist has the right to use public monies for the pursuit of abstract research which he or she has selected purely on the basis of his or her own intellectual curiosity, or whether he or she is obliged to attack problems which have social priority (for example, pollution problems). Even more basic, perhaps, is the question whether society (i.e., the government) has the right and/or obligation to enlist scientific research in its attack on social problems. Can and should the government, that is, mobilize the forces of the scientific community to work on problems which it (society) rather than they (the scientists) select?

"Scientific research is value-free. Scientists select topics for research on the basis of their own interests. Outside political, social, economic, or other factors are of minor significance in the research scientists choose to do." This is an argument made often by scientists. What evidence or opinions do you know of that suggest this argument might not be completely true? What factors can you think of, for example, that might influence this scientist's decision to study the flow of blood through a capillary? (photo courtesy of the National Institutes of Health)

Case Study: A department of science and technology

With predictable regularity, bills to create a new Cabinet-level Department of Science and Technology appear in the Congress. The one outlined below is fictitious, but it represents ideas which have been proposed for such an agency. To supply the necessary background, we'll suppose that the bill was created and drafted in the executive department by nonscientific advisors to the president. It was then passed to a sympathetic member of the House, who introduced it as HR 4558.

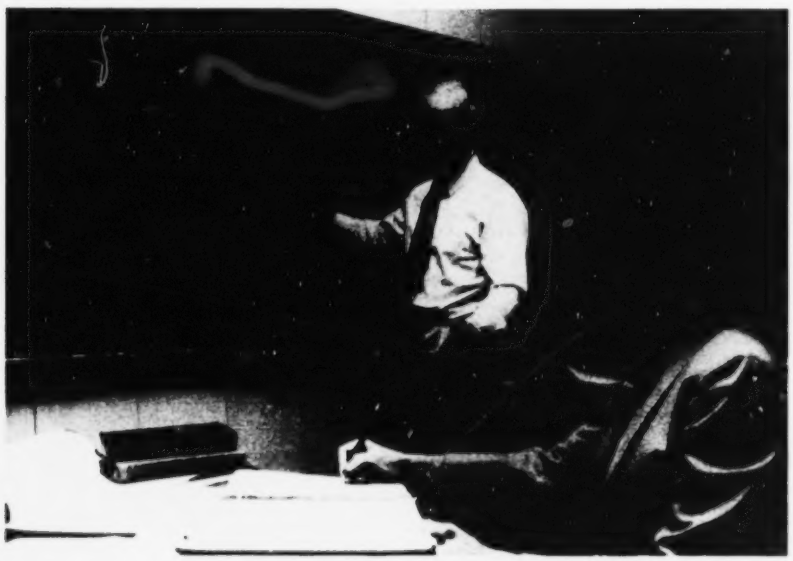
HR 4558: A Proposal to Establish a Department of Science and Technology

Abstract

This bill recommends to the president that he establish a new cabinet-level Department of Science and Technology. The new department is seen to be desirable because of the increasingly important role which science and technology are playing in our society. It no longer seems wise to allow science and technology to develop in a haphazard, disorganized way. The time has come to bring the forces of scientific research under control and use them for the solving of social and economic problems we face in this country.

The nature of the proposed department is described herewith:

1. The responsibility of the department will be to determine the research programs in science which should have priority in American society over the next ten years. Priority will be given to those programs which have the greatest probability of contributing to the health, safety, happiness, and general welfare of the American public.



2. The policy-making body of the department will be the Central Planning Committee for Science (CPCS) consisting of thirteen members: the Secretaries of Labor, Commerce, Transportation, Housing and Urban Development, and Interior, the president's science advisor, representatives from the National Association of Manufacturers, the American Medical Association, and the Junior Chamber of Commerce, and four nonscientist members selected at large by the National Science Foundation.

3. The CPCS will operate under the same principle as the Department of Defense, i.e., that civilians should make the policy decisions and have overall control over the operations of the specialists, in this case, scientists.

4. The CPCS will not only make policy decisions, but will take such actions as seem necessary to carry out those policies. This might include such activities as providing financial support to those research projects which contribute to the attainment of priority objectives, assigning research projects to various cooperating university departments of science, and providing financial aid (grants, scholarships, interest-free loans, etc.) to college students who agree to work on priority projects after their graduation.

5. In order to permit the department to carry out the goals mentioned in N4, all nondefense funds for scientific research and development will be transferred to the control of the Department of Science and Technology.

The Buck Stops Here

As a member of a bipartisan study committee of the League of Women Voters, you have the opportunity of seeing an advance draft of the bill and making any comments you care to on it. As a public-spirited citizen concerned with the role of science in modern society, what would be *your* position on this bill?

Additional Questions

1. The character of scientific research has changed rather dramatically in the last fifty years. Find a specific example that illustrates how this statement is true in terms of cost, equipment, number of workers, amount of professional training, etc.

2. Does a scientist ever have the right to use public tax money for the pursuit of questions that arise purely out of his or her own curiosity? Explain your answer.

3. The planning of scientific research outlined in HR 4558 corresponds to the way science is supervised in the Soviet Union and some Eastern European nations. What difference does that make (if any) on the answer you gave in *The Buck Stops Here*? Explain.

4. Do you think the CPCS would recommend *any* funds for basic research? If you say no, explain why not. If you say yes, tell which projects they might support.

5. Explain in more detail the principle alluded to in point #3 with regard to the Department of Defense. Then explain why the same principle would or would not apply to scientific research.

6. How effective do you think the membership of the CPCS (point #2) would be in carrying out the objectives of this bill?

7. "No one can complain about the objectives or provisions of this bill because the government assumes no responsibility at all for research conducted with nonpublic funds." How do you feel about this argument?

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Topic five
Too much, too far, too fast? Disenchantment with science

Introduction

The two decades following World War II were undoubtedly a "golden age" for science in the United States. Both government and the average citizen had been enormously impressed by the successes of scientific research during and shortly after the war. Developments such as radar and atomic power opened the eyes of laypersons to the enormous potential of science and technology in everyday life. Scientists received recognition, honor, and financial support with an enthusiasm that had seldom been seen before. The government in particular began to recognize that victory in war and domestic progress belonged to those nations which had developed strong scientific and technological establishments. By 1960, concern for the needs of science ranked just behind the flag, motherhood, and apple pie!

By the middle of the 1960s, however, the unquestioned acceptance and recognition which scientists had begun to take for granted began to be challenged by critics of the Great God Science. Undesirable side effects of technological progress, such as air and water pollution, had begun to appear. It became obvious that continuous scientific progress was not automatically "all good." With the next half decade, a quite remarkable reversal developed in the public's attitude toward science. For many, admiration changed to distrust, unquestioning support changed to qualified acceptance, and the financial horn of plenty became an austerity-level budget. Thousands of graduates in science, encouraged and supported through high school and college during the boom of the late 50s and early 60s, found at the dawn of the 70s that jobs had become scarce. Those that were available required skills for which they had not been trained. What happened in the late 1960s to produce such a dramatic backlash against science and technology? There are at least two possible answers to that question. The first of these is the subject of this topic, while the second is considered in Topic Six.

Anyone who lived through the late 1960s would recognize some obvious causes for the public's disenchantment with science and technology. Much that was "wrong" in the daily news seemed to be traceable to the work of scientists: a horrible and inhuman war conducted largely through the resources developed by American scientists; a rapidly increasing loss of privacy caused by "improved" electronic surveillance and increased computer efficiency; a widespread degradation of the environment resulting from phosphate-based detergents, oil-slicks, increased fuel consumption, inefficient automobile engines; and a host of other science-related phenomena. More than that, while two-thirds of the world's population was daily fighting malnutrition or starvation, and pockets of abject poverty survived in our own country, the federal government was able to find billions of dollars for the most dramatic "pure" research project in all history: a trip to the moon! Whether you agree or not that science was the cause for these developments, it's evident that in America of the 1960s, there were many good reasons to question the role of science and technology in modern society.

Perhaps the most intriguing aspect of the whole backlash phenomenon was the part played by some scientists themselves. In a crisis of conscience not unlike that experienced by the atomic bomb researchers in the late 1940s, a number of researchers and graduate students in the 1960s rose to question the role that science—and they

as scientists—had assumed in modern society.

The 1980s seem to promise a continuation of the government's and the public's schizoid view about science and technology. Americans still clamor for the benefits of scientific and technological research . . . but object strongly to the harmful side effects that accompany these benefits. The government calls for more innovation, more research, more development . . . but is no longer eager to support science and technology. A strong conservative movement in the nation rejects scientific and technological approaches to the world's problems, calling instead for mystical or religious solutions.

The case study below is fictitious, but reflects the feeling of some both within and outside of science who feel that we need to look someplace other than science for the next steps in human progress.

Case Study: A moratorium on science?

The Daily Eagle

Vol. CCXVII August 13, 1992

SCIENTIST CALLS FOR MORATORIUM ON RESEARCH

Says society must assimilate present knowledge before acquiring new.

Buffalo, Friday (ANS) . . . . The world was shocked today when Dr. Gilbert J. Halsteed called for a five-year moratorium on scientific research. "We haven't yet learned how to live with the knowledge gained in the past 50 years," the eminent physicist said, "so how can we go on adding to our storehouse of 'informed ignorance'?" Halsteed was speaking at a testimonial dinner given by his graduate students and colleagues in honor of his forthcoming retirement.

Halsteed gave particular attention to the unknown and unexpected uses to which scientific knowledge has been put by the present generation of politicians. "It's impossible to know," Halsteed pointed out, "the way in which a scientific discovery will be used by society. But it's clear from recent history that if there is a 'bad' way to use something, someone in society will almost certainly find and use that way." Halsteed was especially critical of the tendency of so many scientists to devote their efforts solely to the production of harmful and destructive materials, such as napalm and the "smart" bombs now being used in the Indo-Caucasian War.

The core of Halsteed's argument is that a perfectly satisfactory standard of living has already been achieved through scientific progress. The technical "know-how" needed to provide every living human with a safe, healthy, and happy life is already available. What the world needs now is not more scientific progress that will produce more goods and material wealth, but an improved kind of humanity that will allow us to use wisely the discoveries and inventions we already have.

"Let's quit worrying about new cars that are 1 percent better than last year's, television sets that are 1" larger, and aspirin tablets that cure headaches in 45 minutes instead of 60. Let's concentrate our research money on improving our understanding of the ways in which people interact with each other and the methods we can use to promote love and understanding among peoples!"

The Buck Stops Here

You are a high school senior or college freshman who has just read the above article in your daily paper. You are surprised by Dr. Halsteed's recommendations and begin to think about a question to which you have given little attention before. List as many reasons as you can think of to support Dr. Halsteed's position. Then, see how many arguments against his position you can develop. Finally, write a brief "letter to the editor" that explains how you feel, overall, about Dr. Halsteed's suggestion.

Additional Questions

1. Dr. Halsteed's recommendations might seem reasonable and appropriate at some periods of history and illogical and inappropriate at other times. Explain why this might be so.

2. The text describes two recent periods of history during which scientists were (1) highly respected and later (2) feared and mistrusted. How do you assess people's attitudes about the scientific community at the present moment? What evidence do you have for your judgment?

3. Professor Halsteed is quoted directly at three points in the above article. Select any one of these quotations and write a brief, direct response to it.

4. Do you think Halsteed's challenge in the last sentence of the article is realistic? That is, can it be achieved? Explain.

5. Dr. Halsteed's recommendation is a rather extreme one: halting *all* scientific research. Is there a less severe change in science that could be instituted and that would achieve the same objective?

Background Reading List

Probably the best single source for articles on the perceived misuse of science is the publication *Science for the People*, a monthly journal produced by a group of the same name and available from Science for the People, 897 Main St., Cambridge, MA 02139. SftP has also produced a number of pamphlets and articles dealing with specific examples of what they see as the misuse of science by government, corporations, and other parts of society.

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Topic six
Is science an illusion? The myth of objective consciousness

Introduction

The second kind of criticism made of science in recent years concerns more fundamental issues. The focus of these attacks is the basic philosophical framework and the methodological system upon which modern science itself rests. In a sense, the attack is less on science itself than it is on "the scientific mentality" and the influence that way of thinking has had on other aspects of our lives.

One common feature of all human societies seems to be that each holds a single dominant outlook on life which is common to all members of that society. This "cultural philosophy" is a generally (and unconsciously) agreed-upon mode of looking at and interpreting the world. It strongly influences, and may even determine, the attitudes and behavior of the members of that society. This does not imply that every person will follow a single set of guidelines in every situation he or she encounters in his or her life. Rather, important institutions and decisions on both a group and individual level are likely to be shaped by and strongly reflective of the common philosophy.

The dominant theme in primitive and prehistoric societies was likely to have been a "magical" one. Events in the natural world and interactions among humans were strongly influenced by, if not actually controlled by, unseen "spirits," according to the dominant beliefs of these cultures. The activities and behaviors of members of these societies were determined by the need to propitiate and, perhaps, manipulate these spirits so as to produce good crops, bring about satisfactory marriages, achieve victory in combat, and so on.

For much of "civilized" history, the dominant theme of various social groups has been a religious one. In many cases, a religious outlook on the world has evolved from (and supposedly improved upon) the more primitive "magical" outlook of our primitive ancestors. At any rate, most modern religions have stressed the need to understand and conform to some code of behavior established by a supernatural being or beings.

The rise of modern science in the sixteenth century brought about a philosophical revolution which was as drastic and widespread as humankind had ever seen. The whole outlook on nature, human beings, and the world which Copernicus, Galileo, Harvey, Descartes, Newton, and their colleagues proposed had a revolutionary effect not only on science and technology—on the study of stars, atoms, electricity, plants, and animals—but also on the way in which people viewed their world and their own place in that world. Of all the changes which modern science brought to philosophy, the most important may well have been its insistence upon *observation and reason* rather than upon *faith and revelation* as the source of truth.

The difference in outlook of a *scientific* (or rationalistic) philosophy, as opposed to a religious or magical or mystical or artistic or some other kind of philosophy is very complex and can hardly be discussed in detail here. You have only to consider the various ways in which an aboriginal shaman, a Hindu priest, and a modern American citizen might attack such problems as

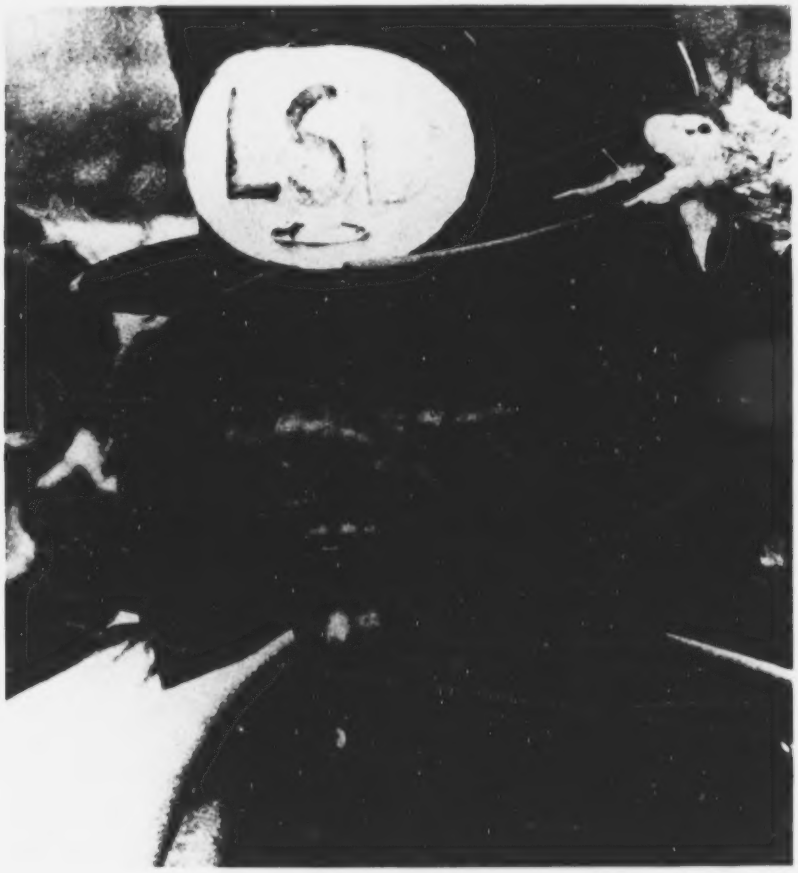
Some people believe that drug use opens up a "whole new world of reality" that cannot be experienced in a non-drug state. What reasons do you have for believing or not believing that this is a legitimate argument? (photo courtesy of the World Health Organization)

increasing crop yields, planning for a happy marriage, selecting a career, or curing a simple illness to see how basically and widely different outlooks on life can influence the way people believe and behave.

For the past 300 years, a scientific or rationalistic kind of philosophy has been gaining ascendancy in Western civilizations. The enormous success of modern science in learning about and controlling nature has made "the scientific mode of thought" increasingly popular and increasingly influential in fields *outside* science itself. Thus, many science teachers would have us believe that the best way to choose a new car, decide who to vote for in an election, or select a life-long vocation is not to cast lots or to pray for guidance, but to use the same careful, logical thinking processes which scientists themselves use in solving scientific problems. Certainly, our society is not completely given over to this rationalistic approach to its everyday problems, but the belief that *reason* rather than emotion (or faith or something else) is the proper way to solve problems that confront us in our everyday lives has largely become accepted as "truth" in our culture.

The first thing you can do in preparation for this seminar is to decide whether the preceding argument is really true. Observe carefully the world around you and decide to what extent "rationalism" is the accepted way of making decisions. Examine advertisements that you see or hear, listen to the advice given to you by friends, teachers, and others, and, in general, try to see how a scientific view of the world impinges on your own beliefs and behaviors.

Within the past few years, there has been a growing feeling in America that the scientific, rationalistic way of viewing problems is either wrong or insufficient. In the 1960s some rebellious youth (the youth "counterculture") felt that emotions, the unconscious, "feelings," intuition, magic, astrology, and other nonrational techniques are important in understanding and interpreting the world. Perhaps the most eloquent spokesperson for this point of view was Theodore Roszak. His book, *The Making of a Counter-Culture*, is one possible topic for this case study. Read Chapters Seven and Eight in this book, answer the following questions and then go to *The Buck Stops Here* following.



Questions

1. What does the term "myth of objective consciousness" mean, and how does it relate to the question of scientific thinking in our society?

2. What evidence do you find not only for the existence of rationalism in American society, but also for the growth of a nonrationalistic or antirationalistic philosophy in our country?

3. What *personal* feelings do you have about the role of rationalism, "the scientific way of thinking," emotionalism, "objective consciousness," etc. in your own daily life?

The Buck Stops Here

Write a book review for your local newspaper on Chapters Seven and Eight only. The review should incorporate your ideas on this topic as contained in your answers to Questions 1-3 above.

Background Reading List

Roszak's book, ***The Making of a Counter-Culture***, is the primary reference for this case. You may also refer to his later work. ***Where the Wasteland Ends***, and his review of J.R. Ravetz's ***Scientific Knowledge and Its Social Problems***. New York: Oxford University Press, 1972, in ***The Nation***, March 172, pp. 405–407.

It will probably be helpful for you to read some reviews of Roszak's book also, for example: Jerome Kirk in ***The American Journal of Sociology***, March 1970, p. 893; Jerald Katz in ***American Social Review***, October 1970, p. 971; and J.R. Coyne in ***National Review***, December 1969, p. 1230.

An interesting interview with Roszak and commentary on his books can be found in Nicholas Wade. "Theodore Roszak: Visionary Critic of Science." ***Science***, December 1, 1975, pp. 960–962.

The most recent manifestations of the thoughts of Roszak are to be found in the writings by and about Jeremy Rifkin. For a background on Rifkin's views, see Yvonne Baskin, "Doctoring the Genes." ***Science 84***, December 1984, pp. 52–60. Andrew C. Revkin, "Jeremy Rifkin: Devil's Advocate." ***Science Digest***, May 1985, p. 55+; and/or more recent articles about Rifkin.

Topic seven Issues of privacy and security

Introduction

In late February of 1985, Professional Baseball Commissioner Peter Ueberroth made an eagerly- and long-awaited announcement. The announcement concerned his decision about 21 professional baseball players who had previously admitted to using illegal drugs. Among the players involved were superstars Joaquin Andujar and Keith Hernandez. Many of the players had, a year earlier, received immunity from prosecution in exchange for testifying against nonathlete drug dealers.

Commissioner Ueberroth's resolution of this issue was to offer each of the athletes a choice between two options: (1) be suspended from professional baseball for one full year or (2) donate 10 percent of their base salary to a drug-abuse-prevention program, submit to random drug testing in the future, and contribute 200 hours of volunteer time to a drug-related community service. Most observers agreed that Ueberroth's decision was a severe one. Players were faced with the loss of income and, perhaps, even their careers if they chose not to agree with alternative (1). Commissioner Ueberroth defended his actions by saying that professional baseball players are role models for the nation's youth. The game can not allow itself to be disgraced and degraded by drug-users, he said.

The problem that prompted Commissioner Ueberroth's action was not an isolated incident. The year 1985 was characterized by a rapidly growing concern about the use of illegal drugs, most prominently, cocaine. Commissioner Pete Rozelle of the National Football League also faced the question of what his sport should do about drug use among professional football players. NFL players had already agreed to a drug-testing program as a result of their most recent contract negotiations. Rozelle wanted, however, to expand the drug testing to the off-season months.

The National Football League Players Association offered to agree to the new provision in exchange for other contract concessions on the part of owners. At the time of this writing, the methods by which professional sports will deal with its drug-using employees is still not entirely resolved.

Drug use was certainly not a professional sports problem exclusively. For example, President Reagan's Crime Commission recommended in 1985 that mandatory drug tests be administered to all government employees and all employees of firms doing business with the government. By some estimates, 2 million individuals would be involved in such a testing program.

On the one hand, it's easy to understand the nation's growing concern about drug use. Studies show that the use of illicit drugs, especially marijuana and cocaine, increased during the early 1980s. That increase itself may have been less significant, however, than the more conservative atmosphere sweeping the nation after 1980.

Practices which might have been approved—or at least produce no widespread backlash—during the '60s and '70s were now branded as criminal, sinful, and/or evil. First Lady Nancy Reagan's decision to make drug abuse her special area of concern at the White House reinforced the nation's new mood about the use of "recreational" drugs.

Drug use was also seen as a special problem in particular areas of society. Professional athletes were thrust into the limelight first and with the greatest fanfare. Many people inside and outside of sports found it hard to picture their "idols" as fallible . . . perhaps as "druggies." A lot more was at stake than a

person's personal life; the "Great American Pastime" had fallen under a cloud of suspicion.

The threat drug use posed for security was a second reason for concern about this problem. Government officials and officers of private corporations alike claimed that users of marijuana and cocaine were less reliable, less dependable, less trustworthy—in all, less desirable employees—than were their nonuser colleagues. Massive testing programs were proposed, designed, and, in some cases, put into operation. Regular mandatory tests for illegal drugs began to be required for hiring and/or continued employment.

In most cases, employers have acknowledged that mandatory testing is a serious invasion of one's private life. What could be *more* of an invasion than to have to produce a urine sample from time to time as a condition of employment? Still, these same employers have argued that this action is not an unreasonable request from someone whose salary they pay and from whom they expect an honest day's work.

Enthusiasm for mandatory drug testing is not, however, unanimous. Opponents of the practice raise at least four objections. First is the invasion of privacy issue, mentioned above. Second is the reliability of drug tests themselves. No existing test is 100 percent reliable; some have been known to give incorrect results as much as 25 percent of the time.

How should an employer respond to the news that Ms. R. tested positively for cocaine when Ms. R. adamantly insists that she has never used the drug? Already horror stories of employees' being fired on the basis of erroneous test results are going the rounds.

For many people, the worst aspect of mandatory testing is the *presumption of guilt* to which the employee is exposed. Administration of mandatory testing is based on the premise that one or more individuals is guilty of drug use. The burden is on each individual employee to prove that he or she is not guilty. This policy represents something of a departure in a society where the law normally presumes a person is innocent until proved guilty.

Finally, some critics argue that the use of marijuana and cocaine is no more nor less of a problem than that of other drug-related issues that have been around for years, and about which we have done little. Smokers, for example, are addicted to the drug nicotine and, by its constant use, contribute to the largest single, preventable disease in North America today: lung cancer. And the intemperate use of alcohol results in untold loss of lives and property each year. Yet no one has ever chastized a professional baseball or football player for smoking, drinking, or encouraging (through advertisements) others to do the same.

Closely related to the question of mandatory drug testing have been recent proposals for mandatory polygraph (i.e., "lie detector") tests. In fact, President Reagan announced on November 1, 1985, that at least 10,000 senior administration officials with access to top secret information would be required to take polygraph tests. An immediate and vigorous response by some of these officials—Secretary of State George Schultz among them—caused the President to back off from this policy, at least for the time being.

The polygraph has been around for a long time. It was invented as a medical device in 1906 and was first used for criminal cases in the early 1930s. The principle behind the device is that a person's statements can be judged to be true or false on the basis of his or her physiological responses at the time of those statements. Thus, the picture we have of a suspect hooked up to a machine with vibrating needles jerking and jumping as the person responds to an operator's questions.

The notion that a machine can detect dishonesty is extremely attractive to many individuals and organizations as witnessed by the fact that more than half of the nation's banks and retailers admit to using a polygraph at least some of the time.

As with drug testing, 1985 was an especially significant year for proponents of polygraph tests. In attempting to plug leaks from his administration, uncover spies and other disloyal employees, and, in general, weed out undesirables from government, President Reagan enthusiastically embraced polygraph testing in his administration.

The problem is—and has always been—that polygraphs are notoriously unreliable. They simply don't do very well the job for which they are designed. A large volume of research shows that, depending on circumstances, a "lie detector" may be right 90%, 50%, or 12% of the time. Partially reflecting this fact, a report by the Office of Technology Assessment (OTA) (also in 1985!) recommended *against* the mandatory use of polygraphs with public and private employees.

The relatively small number of drug-users, spies, or criminals who might actually turn up during polygraph testing, the report pointed out, would almost certainly be much smaller than the number of innocent citizens who would falsely be branded as guilty of some offense.

With a record like that of the polygraph, critics argue, what worker in government or the private sector would be willing to put his or her job on the line in a polygraph test? Yet the technique continues to hold strong appeal for those who want to cleanse society of its unreliables and deviates. As a very high government official in the 1970s was

quoted as saying (about a government report on pornography): 'I don't care what the facts are; I know what I believe."

Case Study

Although "only" a freshman, you have decided to run for Treasurer of your school's Student Government Association (SGA). You have always been interested in politics and hope to make a career in some level of government. You feel that an early start in SGA is important, and this election is your first opportunity to become really involved in school politics. You have met a lot of your fellow students already and have every reason to believe that you can get elected.

The only factor that makes you hesitate to take out nominating papers is the school's new policy on mandatory drug testing. Concerned about what it believes to be a "drug epidemic" on campus, the administration has decreed that all students who hold office in any campus organization must agree to periodic, unannounced urinalyses. Any student who fails two consecutive tests is automatically removed from his or her office and suspended from school for one academic year.

You have heard the arguments for and against drug testing in a somewhat abstract sense in your course in Science and Social Issues at school. Now you have to deal with that issue in a real setting.

The Buck Stops Here

Prepare a list of reasons *for* and *against* running for SGA under these circumstances. Then, tell which choice *you* would make and why.

Additional Questions

1. In your opinion, why is the abuse of cocaine and marijuana seen as a major social problem today and abuse of nicotine and alcohol not?
2. On the basis of your own information, or from research that you do on this question, decide whether professional sports figures have traditionally been desirable role models in the past (i.e., over the past 50 years). Use specific examples to illustrate your answer.
3. Is it worse for a professional football player to use cocaine than it is for your aunt to use the drug? Why or why not?
4. Express you opinion on whether mandatory drug testing is or is not a legitimate invasion of a person's privacy. If your answer depends on conditions, state what those conditions are.
5. Nearly everyone understands the unreliability of drug and polygraph testing. How do proponents of mandatory testing deal with this fact of life?
6. Find out what "false positives" and "false negatives" are in drug testing. What relevance do these kinds of results have for this issue?
7. How, *specifically*, does drug use (you select the drug to discuss) affect an employee's work performance?
8. Describe the process by which a polygraph operator detects false statements when using the machine.
9. What methods, if any, can a subject use to "trick" a polygraph machine?
10. See if you can locate an organization in your community where polygraph testing is used. Interview a representative of that organization to get his or her view of this issue.

Additional Reading

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Edwards, Diane D. "Nicotine: A Drug of Choice?" *Science News*, January 18, 1986, pp. 44-45. *"More than 20 years after the U.S. Surgeon General first indicted tobacco as a health hazard, new research suggests that habitual nicotine use causes a true drug dependency."*

Flax, Steven. "The Executive Addict." *Fortune*, June 24, 1985, pp. 24-31. *Drug abuse appears to be increasing among executives.*

Holden, Constance. "Days May Be Numbered for Polygraphs in the Private Sector." *Science*, May 19, 1986, p. 705. *Reactions to the use of lie detectors by some individuals and organizations.*

Neff, Craig. "The NFL and Drugs: Fumbling for a Game Plan." *Sports Illustrated*, February 10, 1986, pp. 82-89. *More detailed information on the situation described at the beginning of this case.*

Sanoff, Alvin P. "Baseball's Drug Menace." *US News and World Report*, March 17, 1986, p. 57. *A commentary on Commissioner Ueberroth's decision.*